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December 11, 1986

AD HOC COMMITTEE ON AMATEUR RADIO DIGITAL COMMUNICATION

Gentlemen:

Enclosure A is a December 11, 1986 draft of an Interim Operations Plan for Amateur Radio Ionospheric Packet Autoforwarding Net. Please review and let me have any recommended changes by December 31.

The plan follows, but further develops, the general concepts presented in the letter, dated July 16, 1986, sent to over 50 HF packet operators. This response from HF PBBS stations was unanimous except for W9ZRX, who objected to his and AD8I's being left out of the original seven-cluster scheme -- both are in the revised (10-teleport) scheme. Enclosure B is a December 4 update of the Summary of Responses from HF GateWay Operators. The Frequency Coverage column is not up-to-date as I do not have accurate data on who went in a recent move from 14107 to 14109 kHz.

The main new input to the concept was the IONCAP predictions for all teleport-to-teleport paths. (See Section 6 of the plan for background). I was expecting to see a pattern that would have the eastern time zone change (day/transition/night) frequencies first, then roll across the country with the sun. Wrong. It turned out that a fully connected network of this kind needs to have all stations change at the same time as it is the midpoint (not local time) that controls. Since the midpoint for many paths is the middle of the country, it works. The only casualties are reliabilities in the eastern and Pacific time zones, which differ greatest from the network midpoint time. These zones are affected only for an hour before or after frequency changes; even then there is usually one good frequency. The numbers in the frequency tables (Annex A) represent Dec-Jan-Feb SSN=5 frequencies. I'll be crunching numbers for Mar-Apr-May SSN=5 before they're needed.

Jon Bloom, KE3Z, tells me that he should have no problem turning these frequency tables into FWD.TNC files that can be used with the WØRLI PBBS autoforwarding software. The predicted SNRs (in dB/Hz) and minimum number of relays will drive the route selection. Until a better number is found, 49 dB/Hz or greater will be considered a good path. That would give about a 15-dB SNR in a 2.4-kHz bandwidth.

There is still much work to be done on integration of the packet network with NTS and ARES, particularly at the endpoints of the packet net. Section 8 of the plan is a place holder for these considerations. The Field Services Department is working on a draft for Section 8. Public Service Manager Mike Riley, KX1B, is in frequent touch with the various groups that have a stake in this problem: the Blue Ribbon Committee, the Emergency Communications Advisory Committee, and the NTS Area Staffs. As everyone appreciates, it is a lot like completing a jigsaw puzzle with parts from several sets.

The next step will be to send this draft to the 40 respondents to our questionnaire, which I plan to do next week. The cover letter will ask them to look it over carefully, advise what vernier adjustments are needed to make it work, and say when they can implement the plan on a trial basis.

73,

Paul L. Rinaldo, W4RI
Chairman

cc: Vice Director Comstock, Chairman, BRC
Joel Kandel , Chairman, ECAC
Director Stafford

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D R A F T

INTERIM OPERATIONS PLAN

FOR

AMATEUR RADIO IONSOPHERIC PACKET AUTOFORWARDING NET

"SKIPNET"

December 11, 1986

American Radio Relay League
225 Main Street
Newington, CT 06111

FOREWORD

A grassroots Amateur Radio ionospheric packet message-forwarding net has sprung to life across North America and elsewhere. Much of the impetus was the spontaneous enthusiasm of about 35 active operators. Credit is due Hank Oredson, WØRLI, for his development of the Packet Bulletin Board System software that made possible automatic forwarding of messages.

This spontaneous net evolution limited the net from reaching its full potential of speedy delivery of messages (say) anywhere in the United States. Well-burned-in frequencies just above 14,100 kHz had serious contention problems. These 20-meter frequencies were not always optimal for the paths, seasons and times of day. Some relief was obtained by some stations covering 7093 kHz whenever the 20-meter band was out. The geographical distribution of stations was more a function of the locations of the volunteers than demographics or points of communication.

Present FCC rules permit operation of packet-radio stations under automatic control only above 50 MHz. This is seen as an impediment to a fully effective HF packet-radio network. In the FCC proceedings of PR Docket No. 85-105, a number of comments recommended authorizing automatic operation below 50 MHz. The FCC denied this under this Docket but invited an ARRL request for Special Temporary Authority (STA) to demonstrate the feasibility of operation under automatic control at below 50 MHz.

Prior to expiration of the STA (assuming the FCC grants it) and possibly for some evaluation period thereafter, this plan and the network operations it describes are considered experimental. We hope to learn much from net operational experience and comments from all sources. Not only are we interested in the efficient operation of the ionospheric packet network but how it can be meshed with VHF/UHF packet radio and other modes to form an effective and modernized Amateur Radio public-service network.

The American Radio Relay League has been active in packet-radio standards, information exchange and network support. The League's role in packet-network development is that of a planner and facilitator. By its nature, such a network can succeed only with the active cooperation of all involved. Fortunately, there is little disagreement on goals.

This interim operations plan are experimental, thus subject to improvement. Suggestions are invited.

Paul L. Rinaldo, W4RI
Chairman, ARRL Ad Hoc Committee on
Amateur Radio Digital Communication

December 11, 1986

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SECTION 1

INTRODUCTION

1.1 General

This is an interim operations plan for an experimental ionospheric amateur packet-radio message-forwarding net. The short title of this network is "SKIPNET." The name signifies the use of ionospheric propagation for distances in excess of approximately 300 miles. Distances shorter than 300 miles are more appropriately serviced by frequencies above 50 MHz. The additional burden of handling such short-haul traffic on SKIPNET would tend to congest the ionospheric network frequencies.

1.2 Situation

a. Normal communications services are vulnerable to outages as a result of natural or manmade disasters.

b. Even when all communications links are functioning, major emergencies on the scale of the Mt St Helens volcano eruption can seriously overload existing channels.

c. There have been, and will continue to be, instances when Amateur Radio is the only viable communications service to/from a disaster scene.

d. Where lives are at stake, communications service is needed within minutes from the disaster scene to anywhere in the country that could provide the required assistance.

e. Communications emergencies can affect almost any size geographical area from a small town to the entire country and may last from hours to weeks.

1.3 Assumptions

a. The onset of emergencies will be with little or no warning.

b. Commercial and governmental services will not be able to accommodate all communications needs during emergencies.

c. By virtue of their distribution throughout the general population, amateurs and their gear will be at, or be permitted access to, the disaster scene.

d. This network will be permitted to operate during any and all emergencies.

1.4 Guiding Principles

a. General-population, served-agency, and Amateur Radio demographics need to be considered in distribution of network resources and development of traffic routes.

b. The network must be suitable for both normal and emergency situations. As emergencies occur with little or no notice, the packet network must be in place and operating automatically at all times. There must be sufficient flexibility for reconfiguration during normal-communications outages.

c. The network must interface with other Amateur Radio resources as well as those external to Amateur Radio, both domestic and foreign.

d. Network resources must have an adequate local support base, not just initially but for a permanent, stable structure.

e. The demands placed on any one amateur volunteer must be in keeping with individual capabilities over a sustained period. Any planning must take into account the dynamic nature of communications needs, packet-radio evolution, and the comings and goings of individual volunteers.

f. As most amateur stations are able to operate only one HF at a time because of co-site interference, larger cooperative communications facilities will be formed by clustering of nearby stations.

g. The network must be organized in accordance with MF/HF ionospheric-propagational realities.

h. Stations must be capable of changing operating frequencies in accordance with propagational needs.

i. The number of stations on any frequency must be limited to well below the critical load at which throughput is reduced to provide reserve capacity for emergencies.

j. Planning and station design must permit maximum frequency reuse through use of minimum power needed to provide the required reliability and antenna patterns optimized for the actual paths worked.

k. Routing decisions must make use of the path with the shortest transit time, minimum number of relays and minimum number of retries.

l. Funding for station installation and operation will be provided by the station sponsors, either individual licensees or hosting organizations.

1.5 Terminology

a. **Network.** "(1) A series of points interconnected by communication channels. (2) An interconnected or interrelated group of nodes." (ANSI/IEEE Std 100-1984)

b. **Station.** "A complete assemblage of radio or television equipment for transmitting or receiving." (Webster's Ninth New Collegiate Dictionary) Station is used to denote one fixed transmit and receive location of a licensed amateur. Stations may have one or more positions to cover different communications needs.

c. **Position.** A unit within a station used to operate transmission and reception on a particular communications channel.

d. **Cluster.** A group of nearby stations associated to perform a related communication function. This plan recognizes that individual stations cannot accommodate positions that cause mutual radio-frequency interference and permits the formation of a larger communications facility through the cooperation of several stations with sufficient geographical separation to permit simultaneous operation.

e. **Teleport.** "An access facility to satellite or other long-haul telecommunications media incorporating a distribution network serving the greater regional community..." (World Teleport Association) In this plan, "teleport" is used to describe only those HF multiport facilities primarily engaged in long-haul domestic and international relay. Although ionospheric long-haul communication is emphasized in this plan, teleports will also use terrestrial line-of-sight intercommunication between clustered stations and for connection to local networks. In future, teleports will also include satellite and meteor-scatter positions.

f. **Skylight.** In this plan, the term "skylight" will describe certain stations that serve primarily as an intermediary between a local area network on VHF/UHF/SHF radio and long-haul communications media (a single HF port now, satellite and meteor-scatter in future). (This is preferred over "HF/VHF GateWay.")

g. **Gateway.** "In packet radio, an interchange point." (The ARRL Handbook) The term "gateway" is widely and loosely used throughout Amateur Radio today making its meaning somewhat obscure unless qualified. In this plan, "gateway" is used only for generic reference to any kind of interchange point. The term "HF/VHF GateWay" effectively is replaced by "teleport" and "skylight," which have more specific functional meanings.

h. **Mnemonic Names.** Pronounceable, capitalized 5-letter names (such as APPLE) are used for reference to teleports and skylights. The names are intended identify these facilities without being overspecific as to location. Also, these names can continue to identify the facility in that same area even after a change of operators/call signs. Names may be self-assigned, but please check with ARRL first to avoid duplications.

SECTION 2

TELEPORTS

2.1 Mission

A teleport is a cluster of nearby Amateur Radio stations cooperating to form a major long-haul relay facility for simultaneous multifrequency communication with (a) other teleports (domestic and international), (b) skylight stations in the served region, and (c) disaster scenes using long-haul communications. In addition, a teleport interfaces with local-area networks (via VHF/UHF/microwaves) and landline networks needed for delivery of amateur traffic. A teleport also provides its own VHF/UHF/microwave intercommunication between stations forming the teleport.

2.2 Sponsorship

Each teleport should be under the umbrella of an organization (for example, a radio club) that is willing to make a long-term commitment to act as host. The host may be an existing organization that covers the area in which the teleport resources are located. It may be desirable to establish a new organization to provide the kind of support needed. If this type of umbrella is not in place at the time of activation of the network, a caretaker should be named to provide the support needed until a host organization is designated.

2.3 Management

Each teleport should designate a manager who is to be responsible for recruiting participating stations, coordinating specific assignments of each operator and station, and seeing that information flows within the teleport and to/from other teleports, and can personally manage all teleport resources particularly during emergencies.

2.4 Voluntary Participation

An advantage of clustering is that individuals can come and go without jeopardizing the teleport. Each operator and station in the teleport is a voluntary resource having individual assets, limitations, preferences, time and energy levels. It is necessary to gather this information and tailor assignments to the volunteers. Individuals will be needed to cover the various operating and other functions, and much will depend upon station location and capabilities. Boredom can be avoided by giving volunteers enough to do. Similarly, burnout should not be experienced if individuals are not pressured to carry more than a reasonable share. Although the volunteers forming the teleport can do their respective functions without ever meeting, regular personal contact is desirable. Recognition is also important in retaining volunteers.

2.5 Teleport Long-Haul Positions

a. Each operational resource in a teleport in this plan is called a "position." A position could be a transceiver (and accessories) that transmits and receives on one frequency (at a time), a single- or dual-port digipeater, or even a receiver (and accessories) used for monitoring. The assumption is that each position is in a location with enough separation from the others to minimize local interference; however, it is possible to colocate HF and VHF/UHF positions without interference.

b. The following positions may be part of a teleport:

(1) Two HF packet positions to work other teleports and simultaneously cover two frequencies per the frequency plan in Annex A. These positions should be capable of operation under automatic control (when permitted by the STA or permanent rule change) and (as soon as possible) should be capable of changing frequencies under computer-program control according to the frequency tables.

(2) One HF packet position under operator control to work skylights in the general region served by the teleport on open-net frequencies provided in the frequency plan in Annex A. (The STA will not include a request for operating these teleport-to-skylight positions under automatic control. Automatic control must await a permanent rule change.)

(3) Optionally, one HF packet position to work overseas teleports (including Alaska, Hawaii, US commonwealths, US territories, and US possessions).

(4) On-call HF SSB/CW position(s) for emergencies.

(5) Optionally, a position to work satellites.

(6) Optionally, a meteor-scatter position.

2.6 Intercommunication

Each teleport must determine its own means of VHF/UHF/SHF packet and voice intercommunication between all positions within the teleport. Ideally, all positions would be within line-of-sight of each other and not need intermediary stations such as digipeaters. To the extent practical, these intercommunication links should be real time, dedicated to this function and free of other users so that they do not introduce unnecessary delay.

2.7 Connection to Local Area Networks

Teleports are responsible for arranging interconnections to VHF/UHF packet local-area networks serving their areas.

2.8 Teleport Locations and Regions Served

a. During its initial operational period, the network is to have 10 teleports in the contiguous United States. The locations have been selected on the basis of the minimum number needed to provide geographical coverage, population distribution, preexisting HF packet stations, anticipated traffic patterns, the need for alternate routes, and propagational realities. It is anticipated that, in the future, teleports will be added in Alaska, Hawaii, US commonwealths, possessions and territories, and in certain other countries throughout the world.

b. The methodology for selecting initial teleport locations started with a map of the United States metropolitan areas to determine how the served population is distributed. Next, ionospheric propagation predictions were examined to find the minimum number of teleports necessary to provide 24-hour reliability over the sunsopt cycle. That yielded an answer of seven locations located at major population centers (roughly: Seattle, Los Angeles, Denver, Dallas, Chicago, Miami, and the northeast corridor). These rough locations were used in a questionnaire sent to over 50 HF packet-radio operators. The completed questionnaires and comments from the respondents contributed to the questions of how many relays are needed and where. An analysis of the general-population and amateur-population numbers for the regions that might be served by the seven candidate locations revealed inadequate service along the west coast, the Midwest/Great Lakes and the northeast corridor. Also, it was evident that two teleports in the Midwest/Great Lakes area would be desirable to split the volume of intercontinental relay traffic. What resulted from this analysis was a teleport distribution that would (a) be small enough in number (10) to permit sharing of a common frequency complement, (b) be sufficient to provide reliable circuits and alternate routing, (c) be in or near major population centers, and (d) serve roughly equal regional populations.

c. Proposed initial teleport locations are listed in Table 2-1, below. Five-letter names are reserved for teleports. The city names were those used for ionospheric propagational studies and are sufficiently specific for frequency selection. Teleport Local Area describes the rough geographical area in which teleport is situated. Region Served gives the general area covered by the teleport for HF packet communication with skylights. Fig 2-1 is a map showing these locations, tentative rough geographical region, general population and amateur population served. Please note that the dot-dash delineations between regions are not meant to establish "turf." In practice, routing responsibilitity will develop largely according to the number of digipeats from each area to a teleport.

d. Anticipated future US teleport are shown in Table 2-2.

e. Fig 2-2 is a map of the world with a suggestion of how teleports could develop internationally in the next few years.

Table 2-1 - Recommended initial teleport locations for the 48 states

Teleport Name	City Used for IONCAP	Teleport Local Area	Region Served	Overseas Service to
CISCO	San Francisco	Bay Area	West	N Pacific
APPLE	Seattle	Seattle-Portland	Northwest	Alaska
ANGEL	Los Angeles	Los Angeles-San Diego	Southwest	S Pacific
ROCKY	Denver	Denver-Boulder Colorado Springs	Mountains	
ALAMO	Houston	Houston-Dallas-	West Gulf	C America
WINDY	Chicago	Chicago-Milwaukee-Indianapolis	Midwest	
LAKES	Columbus	Columbus-Cleveland Detroit	Great Lakes	
DIXIE	Miami	Miami-Palm Beach	Southeast	Caribbean, S America
SWAMP	Washington DC	Washington-Phila corridor	Mid-Atlantic	
YANKS	Boston	New York-Boston corridor	Northeast	Europe

Table 2-2 - Possible future US teleports

Teleport Name	City Used for IONCAP	Teleport Local Area	Region Served	Overseas Service to
HUSKY	Anchorage	Anchorage area	Alaska	N Asia
ALOHA	Honolulu	Oahu	Hawaii	Pacific
MARIA	Agana	Guam	Pacific	Asia
BUENO	San Juan	Puerto Rico	Caribbean	S America

Fig 2-1 - Map of proposed initial US teleport locations, areas and populations served

Fig 2-2 - Map of possible international teleport locations

SECTION 3

SKYLIGHTS

3.1 Mission

A skylight is an Amateur Radio station with the primary mission of being a bridge between the HF packet network and a local-area network (LAN) operating on a frequency above 50 MHz. It uses a single HF port to communicate with (a) other skylights for regional traffic and (b) a nearby teleport for long-haul traffic.

3.2 Sponsorship

Normally, a skylight is sponsored, operated and supported by a single radio amateur or club.

3.3 Voluntary Participation

Any Amateur Radio operator with a General class license or higher may operate a skylight and participate on regional skylight frequencies. This, however, is not a case of "the more the merrier" because of frequency congestion. Generally speaking a skylight is needed at least abovt every 300 miles or so. The object is to ensure that every packet station could get a message to a skylight with no more than about 4 digipeats. This does not mean that one can draw a 300-mile grid across the United States and situate a skylight at every grid intersection. The grid will be greatly distorted by terrain, population distribution and the topology of the local VHF/UHF/SHF packet network(s).

3.4 Skylight HF Position

a. Each skylight will have one HF position to work a nearby teleport on the regional frequency covered by that teleport. That same frequency will be used by skylights for lateral traffic between skylights within that region. Antenna requirements are quite reasonable for suburban lots; horizontal dipoles at 1/8 to 1/4 wavelength above ground are all that is required.

b. Until the FCC rules permit automatic operation below 30 MHz, and operator must be at the control point for the skylight whenever it is transmitting on HF. However, as an operator convenience, it may be desirable to automate the station as much as possible, including frequency changing under program control.

3.5 Connection to Local Area Networks

Skylights are responsible for arranging interconnections to VHF/UHF/SHF packet local-area networks serving their areas.

3.6 Skylight Locations

Annex C gives the latest list of skylight stations, based on information received to respondents to the July 1986 questionnaire.. Fig 3-1 is a map of the skylight locations listed in Annex C. There are obvious holes in the coverage, some because they did not respond to the questionnaire, others have yet to fill the voids.

Fig 3-1 - Map of US skylight locations listed in Annex B

SECTION 4

NETWORK MONITORING

4.1 FCC Views on Packet Radio Monitoring

a. In consideration of PR Docket No. 85-105, which concerns amendment of Part 97 of the rules to permit automatic control of amateur stations above 50 MHz, the FCC was particularly concerned about the possibility of improper usage of the amateur packet network. The Commission noted that "Only after-the-fact screening is possible since the control operator can only indirectly supervise the station tranmissions... While screening of messages at the entry point serves to prevent the introduction of improper messages..., it remains for monitoring by other amateur operators to detect the introduction of messages from non-amateur stations. ...control operators of intermediate retransmitting stations are unable to fully screen retransmitted messages. Thus the present packet network is vulnerable to unauthorized use. The design of future retransmitting networks should take these matters into account more fully." In its decision, the FCC stated that "...control operators capable of monitoring ... must alert the responsible control operator of any intermediate retransmitting station under automatic control of any misuse of the station so that prompt corrective action will be taken."

b. In its Memorandum Opinion and Order in PR Docket No. 85-105, adopted on October 6, 1986, the Commission acknowledged the ARRL's comments concerning safeguards in the AX.25 protocol. The ARRL had stated that detailed records of packet message transfers were maintained automatically. ARRL radiograms, used for third-party traffic, include a serial number and the call sign of the originating station, making it possible to establish a "trail of accountability." These assurances were persuasive in the FCC authorizing automatic operation while relaying third-party traffic on frequencies above 50 MHz.

c. Therefore, it is incumbent on the packet network to detect improper traffic and take prompt corrective action to protect the privilege of automatic operation above 50 MHz currently. An future rule change to permit automatic operation below 50 MHz is contingent on maintaining a clean record of no abuse using automatic operation above 50 MHz as well as on HF.

4.2 Purposes

The purposes of monitoring HF packet network operations are to:

(1) detect, report and discontinue improper traffic;

(2) detect, report and curtail interference that might result from automatic operation;

(3) collect and report statistical data needed for teleport and network management; and,

(4) implement FCC recommendations.

4.3 Monitoring Resources

a. Each teleport should appoint an individual to monitor on-the-air activities of that teleport and those skylights that communicate with that teleport. The monitor immediately should report any problems to those able to take corrective action. The monitor should:

(1) detect any improper traffic;

(2) detect any transmitter malfunction; and,

(3) log and analyze traffic patterns for the purpose of identifying needed improvements.

b. A national monitor coordinator will be designated to:

(1) provide guidance to teleport monitors as to what to monitor and what statistics to generate;

(2) spot check network operations by random or periodic listening on network frequencies for improper usage or malfunction, and report such problems directly to the individuals who are able to take corrective action; and,

(3) collect operating statistics from each teleport monitor, collate and disseminate to those in the network.

SECTION 5

TECHNICAL CONCEPTS

5.1 Station Control

a. FCC rules permit automatic operation of packet-radio stations only on frequencies above 50 MHz. Except as authorized by the STA when in force, all transmissions below 50 MHz must be supervised by a control operator at a control point.

b. When in force, the STA is intended to permit automatic control of only those stations within each teleport assigned to communicate with other US teleports.

c. The STA is not intended to provide for automatic control of stations performing communications between skylights, teleports and skylights, nor between US teleports and those overseas. These stations should remain under operator control until such time as FCC rules are changed to permit automatic operation.

5.2 Antennas

a. Antennas used for teleport-to-teleport links should be designed to favor paths to neighboring teleports.

(1) For teleports in the NW, SW, NE and SE corners of the country, dipoles broadside to the center of the country appear to be adequate for 10.1 MHz and below. Two- or three-element Yagis (such as tribanders) oriented toward the center of the country should do reasonably well on 14 MHz and above. A half-wavelength above ground (less on 1.8 and 3.6 MHz) is sufficient to reach neighboring teleports reliably.

(2) For other teleports, omnidirectional antennas (such as vertical monopoles) should be considered. The vertical takeoff angles of interest are in the 3-30 degree range. Bi-directional dipole patterns may appropriate for some locations if the nulls can be oriented toward azimuths where there are no teleports.

b. Teleport-to-skylight and skylight-to-skylight links are near-vertical-incidence (high-angle) paths, and dipoles would be best for this application. Horizontal full-wave or multiple-full-wave loops have their main lobes overhead and are among the best antennas for such short paths. Vertical monopoles and small horizontal loops overhead and would be unsuitable for near-vertical-incidence paths.

c. Antennas for teleport-to-overseas circuits are basically point-to-point circuits. Unidirectional, high-gain antennas should be used for these paths.

5.3 Transmitter Power

a. Excessive transmitter power can cause interference to others who are trying to use the same frequency. On the other hand, insufficient power may also cause interference as a result of multiple retries. All stations should watch the number of retries for various paths during different parts of the day and make any necessary adjustments.

b. All domestic packet links should restrict their power to 200 watts PEP. Propagation predictions and operational experience indicate that 200 W is adequate for the quality of service required.

c. Overseas packet links should use 200 W to 1.5 kW PEP, depending on circuit conditions. IONCAP propagation predictions may be used to determine which hours of the day that various power levels are required.

5.4 Speed and Modulation

a. Current FCC rules limit sending speeds to 300 bauds for all frequencies below 28 MHz and 1200 bauds in the 10-meter band.

b. The defaults for all SKIPNET operations are 300 bauds and Bell 103-compatible modems (200-Hz shift FSK).

c. The ARRL STA application will seek FCC approval to use 1200 bauds on all MF and HF bands for experimentation on teleport-to-teleport links only. The type of modulation will be determined largely by modem availability. Current modulation options for 1200-baud operation are:

(1) Bell 202 (1000-Hz shift FSK): All stations have this capability. The relatively wide shift (while legal under FCC rules) and noncoherent frequency shift cause it to have wider bandwidth than the other options.

(2) CCITT V.23 (800-Hz shift FSK): Some stations have this capability in the form of the Am7910 modem ship. It occupies slightly less spectrum than Bell 202 and may prove to be a viable choice for 1200-baud HF operation.

(3) MSK (600-Hz shift FSK): Few stations have this capability, and commercial availability of modems is sometime in the future. It would occupy less bandwidth than the other options, above.

d. Kantronics has indicated their willingness to lend, for evaluation, their new Kantronics All Mode (KAM) units to the 20 stations participating in the STA. The KAM is manufactured for the speeds of 300 bauds on HF and 1200 bauds on VHF, and it can serve as a gateway between HF and VHF. As the frequency shift in these units is programmable, Kantronics is conducting tests to determine the KAM's speed performance at shift ranging from 600 to 1000 Hz. We await the outcome of these tests.

5.5 Link-Layer Protocol

The latest version of AX.25 will be used; Version 2.0 is currently in effect.

5.6 Message-Forwarding Protocol

The latest version of the WØRLI Packet Bulletin Board System software will be used.

SECTION 6

IONCAP PREDICTIONS

6.1 Introduction

Most active radio amateurs are familiar with some aspects of high-frequency propagation. Through operating experience, some hams have a keen sense of what frequencies to use and where to look for rare openings. To this extent ionospheric propagation prediction is an art. It is also a science based on millions of past observations and ongoing collection by scientists throughout the world. In the United States, the focal point for this work is the Department of Commerce. World observations are stored and available for practical use in a computer program called IONCAP. Predictions for specific circuits are provided on request (and payment) from the Institute for Telecommunication Sciences (ITS), which is part of the National Telecommunication and Information Administration (NTIA), a Department of Commerce agency.

6.2 ARRL-Requested IONCAP Predictions

a. The League has a standing request for monthly IONCAP predictions for publication in QST. These are based on the specific month of the year and the smoothed running sunspot number predicted for that month. Only the following predictions are shown:

maximum usable frequency (MUF)	a median frequency above which a signal will penetrate the ionosphere half the days and below which the signal will be returned to earth at the desired location half the days during that month. (The MUF has a reliability of 50%.)
highest possible frequency (HPF)	a frequency 15% above the MUF. (If the MUF is 10 MHz, the HPF is 11.5 MHz.) (The HPF has a reliability of 10%.)
optimum traffic frequency (FOT)	a frequency 85% of the MUF. (The FOT has a reliability of 90%.)

The QST curves do not include the lowest usable frequency (LUF) because of many variables. In order to produce a LUF, the computer needs to know such things as transmitter power, transmitting and receiving antenna patterns, manmade noise, and required signal-to-noise ratio for the type of service.

b. In late 1985, ARRL HQ requested long-term, all-season IONCAP predictions from NTIA/ITS for 51 selected paths from Western, Central and Eastern USA to the following overseas locations:

Alaska (61N, 150W)
Hawaii (20N, 155W)
Caribbean (10N, 80W)
Eastern South America (15S, 45W)
Southern South America (35S, 63W)
Antarctica (65S, 60W)
Western Europe (47N, 7E)
Eastern Europe (55N, 35E)
Western Africa (20N, 0)
Eastern Africa (15N, 30E)
Southern Africa (15S, 25E)
Near East (30N, 50E)
South Asia (25N, 80E)
Southeast Asia (15N, 110E)
Far East (38N, 130E)
Australia (25S, 140E)
South Pacific (25S, 175E)

MUF and LUF curves based on these predictions will be published in the new (1987 edition) Operating Manual. The more-detailed IONCAP printouts which show band-by-band predictions, on file at ARRL HQ, were used for frequency planning of overseas packet-radio circuits in this plan.

c. After most HF packet station questionnaires were reviewed in late 1986, long-term, all-season IONCAP predictions were ordered between the following proposed teleport locations within the 48 contiguous United States:

San Francisco (37.46N, 122.25W)
Seattle (47.36N 122.19N)
Los Angeles (34.03N, 118.14W)
Denver (39.44N, 104.59W)
Houston (30.16N, 93.13W)
Chicago (41.59N 87.54W)
Columbus (39.57N 82.59W)
Miami (25.46N, 80.11W)
Washington DC (38.53N, 77.02W)
Boston (42.21N, 71.03 W)

6.3 IONCAP Input Parameters

In order to provide LUFs and circuit reliability predictions, it was necessary to base the IONCAP requests on a typical-station setup. Below are the parameters used for all circuits unless otherwise indicated:

Months	JAN (for DEC-JAN-FEB) APR (for MAR-APR-MAY) JUL (for JUN-JUL-AUG) OCT (for SEP-OCT-NOV)
Sunspot Numbers	5, 60 and 120 SSN
Antennas	
domestic paths	1.8-10.15 MHz dipoles 15 m above ground 14-29.7 MHz 3-element Yagi 15 m above ground
overseas paths	1.8-4.0 MHz dipoles 25 m above ground 4.0-10.15 MHz 3-element Yagi 25 m above ground 14-29.7 MHz 5-element Yagi 25 m above ground
minimum angle	3.0 degrees
Transmitter Power	200 W domestic, 1.5 kW overseas
Type of Ground	Poor
Frequency readouts	1.9, 3.6, 7.1, 10.1, 14.1, 18.1, 24.9 and 28.5 MHz
Required SNR	34 dB/Hz (in dB relative to the noise in 1 Hz. This SNR is suitable for CW.)
LUF Reliability	50%
Man-made noise	-148 dBW

6.4 Reading IONCAP Predictions

a. Here is an example of the heading and one hour readout:

```
                              METHOD 23   IONCAP 78.03

          JAN                      SSN = 5
SEATTLE   TO  DENVER                          AZIMUTHS          N. MI.      KM
47.36 N   122.19 W - 39.44 N  104.59 W     115.46  307.63       899.9    1666.5
                                MINIMUM ANGLE   3.0  DEGREES
POWER =     .200 KW  3 MHZ NOISE = -148 DBW      REQ. REL = .50  REQ. SNR = 34.0

UT   MUF

2.0  8.5  6.6  1.9  3.6  7.1 10.1 14.1 18.1 21.2 24.9 28.5  0.0 FREQ
     1F2  1F2  2F2  1F2  1F2  1F2  1ES  1ES  1F2  1F2  1F2    -  MODE
    15.9 11.5 27.6 11.4 11.9 16.4  3.7  3.7 16.4 16.4 16.4    -  ANGLE
    305. 232. 240. 231. 238. 313. 110. 110. 313. 313. 313.    -  V HITE
     69.  61.  42.  56.  63.  53.  22.  -9. -56. -58. -63.    -  SNR
    -35. -27.  -8. -22. -29. -19.  12.  43.  90.  92.  97.    -  RPWRG
     .99 1.00  .92 1.00 1.00  .84  .29  .02  .00 .00  .00     -  REL
```

b. Below are explanations of the data given in this Method 23 printout:

(1) The first line of the page heading gives the month (JAN) and sunspot number (SSN = 5).

(2) The second line shows the arbitrary circuit labels used: (SEATTLE and DENVER).

(3) Below the labels are the actual coordinates used to generate the predictions (47.36N, 122.19W for Seattle, and 39.44N, 104.59W for Denver).

(4) The azimuth from Seattle to Denver (115.46 degrees) and from Denver to Seattle (307.63 degrees) are shown next, followed by the path distance in nautical miles (N. MI) and in kilometers (KM).

(5) The next line shows the minimum takeoff angle (MINIMUM ANGLE) of 3.0 degrees. That is, takeoff angles of less than 3 degrees are disregarded on the assumption that they are impractical for most Amateur Radio stations.

(6) On the next line of the heading, the transmitter power (POWER) of 0.200 kW or 200 W is used for domestic paths.

(7) The manmade noise measured at 3 MHz is -148 dB below one watt, that of a quiet suburban location.

(8) REQ. REL = .50 says that a required reliability of 50% was chosen for the LUF.

(9) REQ. SNR is the required signal-to-noise ratio referenced to the noise in 1 Hz. The figure 34 is in dB/Hz. This SNR is suitable for CW using a receiver bandwidth of 500 Hz. A ratio of 1 Hz to 400 Hz is (10 log 400 = 26.02) 26 dB, thus an SNR of 34 dB/Hz would yield an 8-dB SNR within that receiver bandwidth. For an SSB or packet bandwidth of 2.4 kHz, the noise itself would amount to (10 log 2400 = 33.8) 34 dB/Hz. So anything above 34 dB/Hz would provide a positive signal-to-noise ratio for SSB or packet. Until a better figure is found, a REQ. SNR = 44 (10 dB SNR within a 2.4-kHz receiver bandwidth) or better is needed for packet.

(10) On the last line of the heading, UT means Universal Time (formerly GMT), and MUF is the median maximum usable frequency. Although not shown, a column heading of FOT would be appropriate immediately to the right of MUF.

(11) On the next line of the example readout, starting from the left, 2.0 is the hour in Universal Time. 8.5 is the MUF in MHz. 6.6 is the FOT. The frequencies 1.9 through 28.5 are operating frequencies selected for this circuit.

(12) The following line is the most-reliable propagation mode for each frequency. 1F2 means one-hop F2 layer. 1ES is one-hop sporadic E.

(13) The next line gives the vertical takeoff angle for the most-reliable propagation mode for each frequency.

(14) The virtual height (V HITE) for the controlling ionospheric layer is given on the next line.

(15) The following line is the predicted available signal-to-noise ratio (SNR) in dB/Hz. Assuming that 49 dB/Hz is needed for packet, reliable communication should be possible more than 50% of the month on 3.6, 7.1 and 10 MHz at 0200 UT over this path. A SNR of 49 dB/Hz would provide a 15 dB SNR in a bandwidth of 2.4 kHz. The SNR performance of HF packet modems needs to be determined.

(16) RPWRG on the next line means required power gain to bring the circuit up to the REQ. SNR. For example 12 dB more effective radiated power (ERP) would have to be added to 22 dB/Hz (line above) to make 14.1 MHz have a SNR of 34 dB/Hz. Minuses indicate a surplus of SNR relative to the REQ. SNR.

(17) The last line shows overall circuit reliability for each frequency based on the REQ. SNR (34 dB/Hz in this case). If a figure of 34 were shown, the reliability would be 50%. Higher SNRs would be needed to raise the reliability closer to 100%. These reliability figures can be used for CW but are much too optimistic for SSB or packet.

6.5 How to Obtain Copies

a. ARRL HQ will provide free copies of IONCAP predictions on file as follows:

Teleports: From that teleport to all other US teleports and those overseas for which it is responsible.

Skylights: A short-distance skywave prediction for that region of the country which is suitable for the path to the nearest teleport.

b. In addition, ARRL HQ will provide copies of any IONCAP predictions on file at $5.00 per copy to cover costs of reproduction. Each long-term all-season prediction runs 36 pages.

SECTION 7

FREQUENCIES

7.1 The Need to Change Frequencies

Changing frequencies according to propagation will assure use of the optimal frequency for each link and will minimize channel congestion by spreading operations over several bands. Paths should be used only when a certain minimum reliability is available. Transmissions should not be made on unreliable paths as they simply interfere with others who can make reliable use of the frequency.

7.2 Frequency-Change Capability

a. Stations operating HF positions should be capable changing frequencies according to propagation. It is desirable that packet-radio stations be equipped to change frequencies automatically at the times given in the frequency tables.

b. Stations unable to change frequencies automatically should endeavor to do so manually, according to the frequency tables. Plans should be made to automate frequency changes when upgrading station hardware and software.

c. As a temporary measure, if your station cannot change frequencies at the times indicated, please discuss what is possible with ARRL HQ so that a modified frequency table can be considered.

7.3 The Need for Specific Frequencies

Because the HF packet autoforwarding network operates automatically and continuously, 24-hour a day, specific frequencies are required. Care is needed in selecting these channels so as not to interfere with other users. When traffic is very light, packet frequencies can be shared with other intermittent users. However, it would be desirable for hams to recognize the packet autoforwarding frequencies, once established, as channels to be avoided for other applications. Experience has shown that it is difficult for packet to share frequencies with RTTY signals, particularly those with multiple bulletin boards, because of the long, uninterupted transmission blocks.

7.4 Allocations and Band Plans

Table 7-1 shows frequency ranges within the MF/HF amateur bands authorized by the FCC for F1B emission and various IARU Region band plans. In addition, those subbands recommended by the ARRL for RTTY are shown. Most subbands shown in the "ARRL RTTY Subband" column are those generally recognized for certain modes in the US and represent part of the "Considerate Operator's Frequency Guide" published in the January 1986 issue of QST. The RTTY subband shown for the 12-meter band was adopted by the Board of Directors in July 1985.

Table 7-1 -- FCC F1B subbands and amateur band plans

FCC RTTY Allocations	ARRL RTTY Subband	R1 RTTY Subband	R2 RTTY Subband	R3 RTTY3 Subband
1800- 2000		1838- 1842	1800- 1830 1830- 1840 DX	
3500- 3750	3590 DX 3610- 3630	3580- 3620	3605- 3645	
7000- 7150	7040 DX 7080- 7100	7035- 7045	7035- 7040 DX	7025- 7035
10100-10150	10140-10150	10140-10150	10140-10150	10100-10150
14000-14150	14080-14100	14075-14099.5	14070-14099.5	14070-14099.5
		18100-18110		18100-18110
21000-21200	21080-21100	21080-21120	21070-21100	21070-21125
24890-24930		24920-24930		24920-24930
28000-28300	28080-28100	28070-28150	28070-28150	28050-28150

Note: IARU band plans afford ±500 Hz protection to 14100-kHz beacons.

7.5 Occupancy

Table 7-2 shows frequencies registered in the latest ARRL Net Directory within the ranges of interest. These frequencies are to be avoided in selection of packet channels.

Table 7-2 -- ARRL Net Directory listings

Freqs of Interest	Net Directory Listings Freqs	Application
1800- 1830	1818	W1AW CW Bulletins and Practice
	1820	Miami Valley Emergency Net (OH)
3580- 3645	3580	W1AW CW Bulletins and Practice
	3583	Southwest Net (AZ/NM)
	3585	Missouri CW Net
		Western Pennsylvania CW Net
	3587	Oregon Section Net
	3587.5	Louisiana RTTY Net
	3590	Empire Slow Speed Net (NY)
		Third Region Net
		Washington Section Net
	3591	Arkansas CW Traffic Net
	3593	Georgia State Net
	3596	Pine Tree Net (ME)
	3598	Southern California Net
	3600	Kentucky CW Traffic Net
		QZX Net (CP)
	3602	First Region Net
	3605	Buckeye RTTY Net
	3610	Eastern Pennsylvania CW Net
		Kansas CW Net
	3615	Louisiana Amateur Net
	3620	Minnesota Section RTTY Net
		New England Teleprinter Net
	3625	W1AW RTTY Bulletins
	3630	New York City-Long Island CW Net
		Northern California Net
		Northern California Net Slow Speed
	3635	Idaho-Montana Net
		Tennessee CW Net
	3637	Nebraska CW Net
	3639.1	West Virginia RTTY Net
	3640	Ninth Region Net
	3643	Maryland-Deleware-DC Traffic Net
	3645	Grey Bruce Net (ON)
		Wisconsin Slow Speed Net
7025- 7045	7030	MUFON Amateur Radio Net (WC)
	7040	Hit and Bounce Net (WC)
	7045	Ontaria Southern Net, Daytime
7080- 7100	7080	W1AW CW Bulletins & Practice
	7083	Southwest Net (AZ/NM)
	7085	Pacific Coast Net (WC)
	7090	Mexican Emergency Net
	7095	W1AW RTTY Bulletins
10140-10150	----	(none)

Table 7-2 -- ARRL Net Directory listings (continued)

Freqs of Interest	Net Directory Listings Freqs	Application
14070-14110	14070	W1AW CW Bulletins & Practice
	14077	Christian Morsecode Training Network (WC)
	14095	W1AW RTTY Bulletins
	14100	Beacons, worldwide
	14105	Pearl Harbor Survivors Assn (WC)
18100-18110	-----	(band not yet authorized by FCC)
21070-21125	21080	W1AW CW Bulletins & Practice
	21080	W1AW RTTY Bulletins
	21110	Planetary Citizen Novices (WC)
	21114	PHD Training Net (MO)
24920-24930	-----	(none)
28050-28150	28080	W1AW CW Bulletins & Practice
	28095	W1AW RTTY Bulletins
	28119	Platinum Coast Novice Net (WC)
	28120	Triple States Intermediate CW Net (OH/PA/WV)
		Triple States Slow Net
	28133	Paul Bunyan Wireless Assn (MN)
	28150	Breezeshooters (PA)

7.6 Required Bandwidth

a. For practical considerations, spacing of HF packet channel should be 3 kHz. Such channel spacing will be necessary to permit 1200-baud operation in future. It would help for 300-baud operation by reducing strong-signal adjacent-channel interference from stations with undesired modulation products.

b. The occupied bandwidth for packet depends on the frequency shift, whether continuous-phase modulation is used, and the amount of filtering in the radio. HF SSB radios have a typical -6-dB bandwidth of about 2.7 kHz, a -26-dB bandwidth of about 3 kHz, and a -60-dB bandwidth of about 4 kHz. Fig 7-1 shows the 14099-14111 kHz frequency range with a typical CW-filter bandwidth for the 14100-kHz beacons and 3-kHz SSB-filter bandwidth for packet. Estimated power spectra after SSB filtering is shown for two types of modulation: Bell 202 (1000-Hz shift) shift), and miniumum-shift keying (MSK)(600-Hz shift). In this scheme, packet "display" frequencies would be 14104, 14107 and 14110 kHz (replacing 14103, 14105, 14107 and 14109 kHz, which do not provide adequate spacing, and 14103 interferes to some extent with 14100-kHz beacons). "Display" frequency is the frequency shown on the transceiver readout when set for LSB.

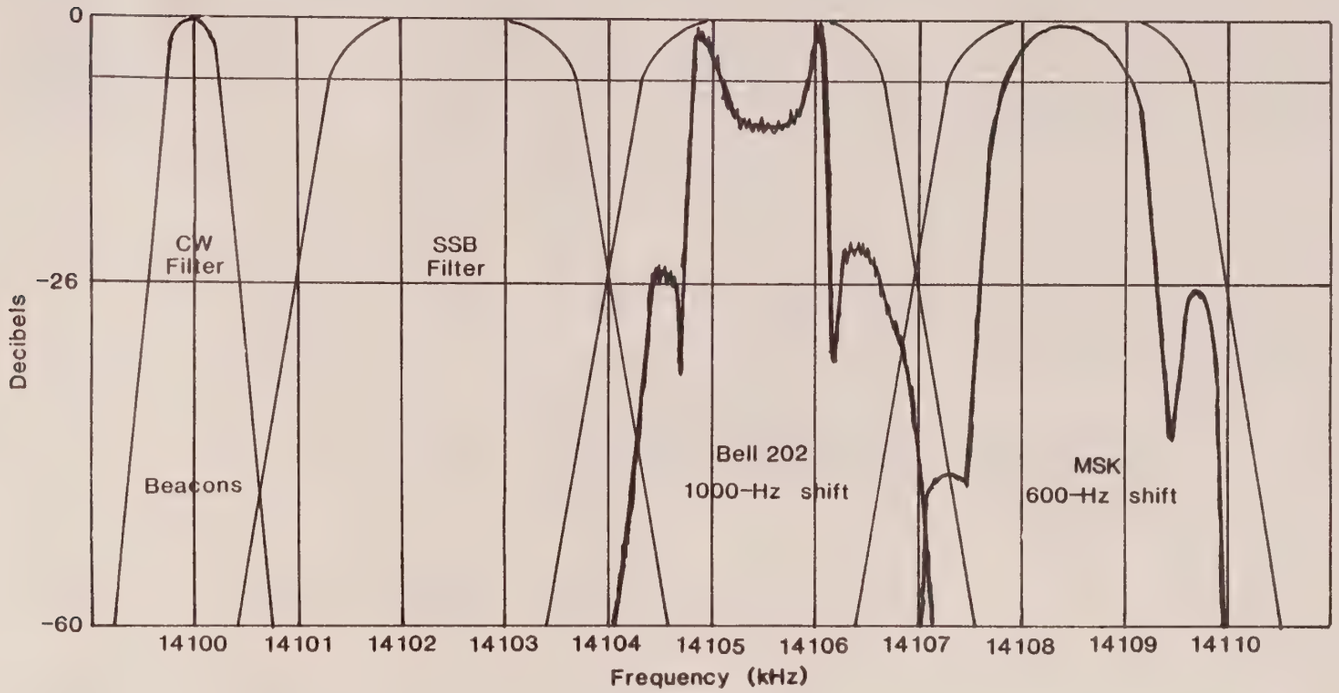

Fig 7-1 - 3-kHz channel raster for 14.1-MHz showing bandwidths

7.7 Frequency Complements

Several complements of frequencies are needed for HF packet autoforwarding: (a) one set of frequencies for communications between US teleports, (b) regional sets for use between skylights and from teleports to skylights, and (c) overseas sets suitable for international use.

7.8 Domestic US Teleport-to-Teleport Frequencies

The domestic teleport-to-teleport complement consists of one channel per HF band, as listed below. These frequencies are to be identified in the STA request.

Table 7-3 -- US Teleport-to-teleport frequencies

Display (kHz)	Center (kHz)	Nearest (kHz)	Known Neighbors Application
3614	3612.3	3610	Eastern Pennsylvania CW Net
			Kansas CW Net
		3615	Louisiana Amateur Net
7093	7091.3	7090	Mexican Emergency Net
		7095	W1AW RTTY Bulletins
10149	10147.3	-----	(None)
14110	14108.3	14115	ARES Net Canada
			DDD Net-Pacific for Canadians
18110	18108.3	-----	(None)
21100	21098.3	21095	W1AW RTTY Bulletins
		21110	Planetary Citizen Novice
24930	24928.3	-----	(None)
28100	28098.3	28095	W1AW RTTY Bulletins
		28119	Platinum Coast Novice Net

Notes:

1. 160 m: Because of the distances involved, a 160-meter frequency does not appear to be needed for teleport-to-teleport communications, even during winter at low sunspot numbers, according to IONCAP predictions.

2. 80 m: The (display) frequency 3614 kHz is new and untried for HF packet autoforwarding. It was one nominated by the Digital Committee in June 1986. It is clear of neighboring frequencies registered in the ARRL Net Directory. Monitoring on the east coast indicates that it is fairly free of other users.

3. 40 m: The (display) frequency 7093 kHz has been in use for packet autoforwarding in the US. It has been generally free of foreign broadcast stations. The sporadic amateur RTTY and SSB phone activity appears to be tolerable.

4. 30 m: The (display) frequency 10149 kHz was nominated by the Digital Committee in June 1986.

5. 20 m: The (display) frequency 14110 kHz is to replace 14109 kHz which is currently in use for US domestic packet autoforwarding. Shifting upward 1 kHz will provide room for 1200-baud operation (subject to FCC approval). It is not in conformity with existing band plans, but on-the-air experience has shown operation above 14100 kHz to be necessary for packet autoforwarding because of the congestion in the RTTY segment.

6. 17 m: This band is not yet authorized by the FCC.

7. 15-10 m: Frequencies in these bands are not needed for domestic teleport-to-teleport use until after several years when sunspot numbers increase.

7.9 Domestic Regional Frequencies

Regional frequencies are those used to communicate from a teleport to skylights in the region served and from one skylight to another in that same region. The distances involved make 80 and 40 meters essential. It is also desirable to have a 160-meter frequency available for nighttime use at low sunspot numbers and a 30-meter frequency available for daytime use at high sunspot numbers.
See Table 7-4.

Table 7-4 -- Regional frequency complement

Display (kHz)	Center (kHz)	Nearest (kHz)	Known Neighbors Application
1804	1802.3	1818	W1AW CW Bulletins and Practice
3634	3632.3	3630	New York City-Long Island CW Net Northern California Net Northern California New Slow Speed
		3635	Idaho-Montana Net Tennessee CW Net
7089	7087.3	7085	Pacific Coast Net (WC)
		7090	Mexican Emergency Net
10146	10144.3	-----	(None)

Notes:

1. These frequencies were selected to avoid teleport-to-teleport frequencies and those listed in the Net Directory but without on-the-air experience.

2. In the event of interference on these regional frequencies, stations may use the domestic teleport-to-teleport frequencies (per Table 7-3) only when they are not in use. Check teleport frequency tables before doing so.

7.10 International Frequencies

It is likely that packet autoforwarding frequencies to and from the United States will vary according to the region worked. Note differences in IARU Region band plans, above. [Frequencies will be added as they are developed in consultation with the IARU member-societies involved.]

SECTION 8

APPLICATIONS

[This section is being developed. A preliminary outline follows.]

8.1 Third-Party Traffic Handling

8.2 National Traffic System Liaison

8.3 Amateur Radio Emergency Service Liaison

8.4 Other ARRL Field Organization Considerations

8.5 National Network Operations Management

SECTION 9

FUTURE DEVELOPMENT

9.1 Developmental Objectives

The following objectives have not been satisfied by this interim operations plan but should be kept in mind for future development. Some may be accomplished within a short time. Others may take years to develop. No particular priority is suggested by the order in which they are listed.

9.2 Additional Teleports

It is anticipated that the network will expand from the original 10 teleports in the contiguous United States to others in Alaska, Hawaii, Puerto Rico and Guam. In addition, additional teleports will be forthcoming in other countries.

9.3 Other Long-Haul Modes

Modes other than packet radio should be considered. On-call MF/HF single-sideband and CW positions should be added. They will be particularly useful for communication with disaster scenes. SSB may also be used as a coordination channel between teleports. Geostationary and low-earth-orbit satellite and meteor-scatter capabilities should be added.

9.4 Compatibility with Other Amateur Networks and Services

Packet-radio message forwarding has developed somewhat apart from the existing National Traffic System (NTS), Amateur Radio Emergency Service (ARES) and Radio Amateur Civil Emergency Service (RACES) in the United States and counterpart organizations in some other countries. The ARRL has formed a Blue Ribbon Committee, chaired by Tom Comstock, N5TC, to study all aspects of amateur communication following a widespread disaster such as the Mexico earthquake. The Blue Ribbon Committee and Ad Hoc Committee on Amateur Radio Digital Communication have been in close coordination to encourage development of a unified approach to message handling.

9.5 Adaptive Transmitter Power

The power output level of Amateur Radio transmitters is now adjusted manually. If transmitter power is kept at the same level most of the time, there are times that the level is inadequate to provide the quality of service required. Conversely, there are times when a lower power level would have provided the required quality of service; excessive power interferes with other users on that frequency. Conditions vary greatly on a momentary basis on the MF/HF bands making it desirable to have the capability of automatically adjusting the power level from one transmission to the next. Software and hardware interfaces need to be developed.

9.6 Frequency Agility

Instead of changing frequencies according to propagation predictions, the path should be sounded and the optimal frequency automatically selected according to changing conditions such as intersymbol interference resulting from multipath propagation.

9.7 Adaptive Antennas

It would be desirable for each transmitting station to automatically reorient a directive antenna for the destination. Call sign information in the AX.25 frame may be used to determine how to select and point the antenna.

9.8 Dynamically Adjustable Sending Speeds

Packet transmission speed should be adaptive in order to achieve minimum retries and most effective frequency reuse.

9.9 Adaptive Routing

Messages should be adaptively directed to take advantage of the best route at a given time.

9.10 Diversity Techniques

Diversity techniques can provide greater reliability and should be considered in new system/station designs.

9.11 Automating the Trail of Accountability

Monitoring, logging and statistical reporting should be automated.

9.12 Near-Real-Time Relay

In addition to store and forwarding with a message being the smallest unit, consideration should be given to a packet-by-packet relay for a circuit through the network. This could provide valuable near-real-time relay service in emergencies.

9.13 Point-to-Multipoint Service

This network provides only for point-to-point packet transmission using the ARQ method specified in AX.25. Sending bulletins (to all radio amateurs) by this method would unnecessarily tie up the network because each message must be sent on a point-to-point (rather than broadcast) basis. A method is needed for rapid and automatic dissemination of bulletins from W1AW through intermediary stations throughout the country without overloading the normal message-forwarding network.

ANNEX A

FREQUENCY TABLES

CISCO Teleport
Dec-Jan-Feb
SSN=5

Time UT	PS	Freqs	APPLE	ANGEL	ROCKY	ALAMO	WINDY	LAKES	DIXIE	SWAMP	YANKS	Region Freqs	Region SN	ALOHA Freqs	ALOHA SN
00	16	7	65	72	60	44	44	41	33	37	35	7	72	14	72
		10	73	4	64	52	51	48	43	44	43				
01	17	7	71	73	61	45	44	38	27	32	30	3	72	14	74
		10	58	39	58	45	42	30	36	32	32				
02	18	3	65	74	53	33	33	35	22	28	25	3	74	14	76
		7	77	50	62	46	44	46	37	40	37				
03	19	3	65	75	55	35	35	37	24	32	29	3	75	10	62
		7	68	48	65	36	36	47	37	42	39				
04	20	3	66	77	59	37	37	40	27	36	34	3	77	7	62
		7	59	43	69	32	29	48	38	44	42				
05	21	3	66	77	59	37	38	37	27	36	34	3	77	7	61
		7	54	36	66	34	31	41	39	45	43				
06	22	3	67	77	60	38	40	34	28	36	34	3	77	7	60
		7	50	29	63	36	34	35	41	47	45				
07	23	3	67	77	60	37	38	36	27	33	32	3	77	7	59
		7	51	27	67	42	41	43	41	46	43				
08	00	3	67	77	60	37	36	39	26	31	30	3	77	7	59
		7	52	26	71	49	48	52	42	45	42				
09	01	3	67	77	58	36	36	39	25	32	28	3	77	7	58
		7	55	18	51	49	48	51	41	44	41				
10	02	3	67	77	57	36	37	39	25	33	26	3	77	7	57
		7	58	26	66	49	48	50	41	44	41				
11	03	3	67	77	58	36	43	36	24	34	28	3	77	7	60
		7	57	22	65	41	40	47	39	45	42				
12	04	3	67	77	60	37	39	34	24	35	31	3	77	7	64
		7	56	18	35	34	32	45	37	47	44				
13	05	7	51	26	67	39	37	43	33	40	37	3	76	7	59
		10	44	10	33	39	37	36	18	15	18				
14	06	7	46	34	69	45	43	42	30	34	30	3	76	7	54
		10	46	10	35	38	34	32	38	43	38				
15	07	7	61	48	63	38	34	16	23	23	20	3	73	7	54
		10	46	7	49	41	39	36	32	38	34				
16	08	10	46	5	63	44	44	41	27	33	30	3	70	10	60
		14	31	0	37	15	0	49	37	44	40				
17	09	10	59	18	62	39	41	38	19	42	25	7	68	10	56
		14	20	0	52	32	25	48	35	39	39				
18	10	10	71	32	61	35	38	35	12	18	20	7	73	14	46
		14	9	0	68	50	51	47	33	34	38				
19	11	10	70	47	59	35	37	35	13	23	25	7	72	14	55
		14	29	0	66	49	50	47	33	38	40				
20	12	10	69	43	57	35	36	35	15	29	30	7	71	14	64
		14	49	0	65	48	50	47	34	43	43				
21	13	10	68	41	58	40	41	39	24	31	34	7	72	14	63
		14	58	0	67	50	52	50	39	45	44				
22	14	10	68	40	60	45	47	43	34	39	38	7	73	14	62
		14	66	0	69	52	55	53	44	48	46				
23	15	7	63	72	54	38	39	35	24	31	25	7	72	14	67
		10	70	22	62	48	48	45	38	41	40				

APPLE Teleport
Dec-Jan-Feb
SSN=5

Time UT	PS	Freqs	CISCO	ANGEL	ROCKY	ALAMO	WINDY	LAKES	DIXIE	SWAMP	YANKS	Region Freqs	Region SN	HUSKY Freqs	HUSKY SN
00	16	7	65	59	58	43	46	43	33	39	37	7	72	10	63
		10	73	64	61	50	52	50	43	45	43				
01	17	7	71	60	57	43	45	46	34	41	38	3	72	7	59
		10	58	59	57	25	49	29	56	29	28				
02	18	3	65	54	56	32	34	37	24	31	26	3	74	7	63
		7	77	62	63	43	44	49	36	43	39				
03	19	3	65	57	56	33	36	35	37	32	29	3	75	7	57
		7	68	66	62	39	40	37	37	39	40				
04	20	3	66	60	56	35	39	33	30	34	32	3	77	3	57
		7	59	71	61	33	37	26	39	36	41				
05	21	3	66	60	56	36	39	33	29	33	31	3	77	3	56
		7	54	66	60	33	39	28	41	40	42				
06	22	3	67	61	57	38	40	34	28	33	31	3	77	3	56
		7	50	62	59	33	41	30	43	44	43				
07	23	3	67	61	56	56	35	32	25	32	30	3	77	3	56
		7	51	63	63	40	37	37	41	45	43				
08	00	3	67	61	56	33	35	31	22	32	29	3	77	3	56
		7	52	64	68	47	34	44	40	47	44				
09	01	3	67	61	57	33	35	16	22	33	29	3	77	3	54
		7	55	67	67	46	40	16	39	47	43				
10	02	3	67	61	58	33	36	2	22	34	29	3	77	3	52
		7	58	71	66	46	47	0	39	47	43				
11	03	3	67	60	57	34	38	1	23	33	28	3	77	3	52
		7	57	68	64	39	43	0	39	46	43				
12	04	3	67	60	57	35	40	1	25	32	27	3	77	3	53
		7	56	66	63	33	40	0	43	46	43				
13	05	7	51	61	65	37	42	19	34	41	36	3	76	3	52
		10	44	35	35	0	41	7	20	40	34				
14	06	7	46	56	67	40	44	37	28	35	29	3	76	3	50
		10	46	36	36	0	41	16	36	43	38				
15	07	7	61	59	50	9	17	7	0	0	0	3	73	7	40
		10	46	52	49	18	44	28	32	39	36				
16	08	10	46	68	62	42	47	40	27	35	35	3	70	7	54
		14	31	25	27	16	42	23	37	45	45				
17	09	10	59	65	61	0	0	0	0	0	0	7	68	7	51
		14	20	48	48	33	47	37	36	44	43				
18	10	10	71	62	60	37	39	38	15	33	30	7	73	10	60
		14	9	71	69	50	52	51	36	44	42				
19	11	10	70	60	59	36	38	38	17	34	33	7	72	10	58
		14	29	69	67	49	52	51	37	45	44				
20	12	10	69	58	59	36	38	38	19	35	36	7	71	14	75
		14	49	68	66	49	53	51	38	46	46				
21	13	10	68	59	60	41	44	43	28	39	39	7	72	14	75
		14	58	68	66	51	47	52	42	49	47				
22	14	10	68	60	61	46	50	47	36	43	41	7	73	14	75
		14	66	69	67	54	40	54	46	51	49				
23	15	7	63	54	55	38	43	40	26	35	32	7	72	14	66
		10	70	62	61	48	51	48	39	44	42				

ANGEL Teleport
Dec-Jan-Feb
SSN=5

Time UT	PS	Freqs	CISCO	APPLE	ROCKY	ALAMO	WINDY	LAKES	DIXIE	SWAMP	YANKS	Region Freqs	Region SN	Australia Freqs	Australia SN
00	16	7	72	59	61	48	45	43	37	39	37	7	72	21	45
		10	4	64	68	43	53	50	43	45	42				
01	17	7	73	60	63	43	45	43	38	40	37	3	72	14	16
		10	39	59	55	48	46	25	35	30	31				
02	18	3	74	54	56	38	36	31	25	30	27	3	74	14	22
		7	50	62	66	39	46	43	39	41	38				
03	19	3	75	57	58	39	37	32	27	32	30	3	75	14	18
		7	48	66	64	41	40	38	40	42	40				
04	20	3	77	60	61	41	38	34	29	35	34	3	77	14	15
		7	43	71	63	43	34	34	41	44	43				
05	21	3	77	60	62	41	39	34	29	36	34	3	77	14	8
		7	36	66	62	44	36	34	42	46	45				
06	22	3	77	61	63	42	40	35	30	37	35	3	77	10	31
		7	29	62	62	46	38	35	44	48	47				
07	23	3	77	61	62	41	38	34	29	35	32	3	77	10	33
		7	27	63	64	44	42	41	44	47	45				
08	00	3	77	61	62	41	37	34	28	33	30	3	77	10	35
		7	26	64	66	43	47	47	44	46	44				
09	01	3	77	61	60	41	35	35	28	33	30	3	77	7	36
		7	18	67	67	46	48	47	43	45	43				
10	02	3	77	61	59	41	38	36	28	33	30	3	77	7	41
		7	26	71	69	50	49	47	42	45	43				
11	03	3	77	60	61	40	39	35	27	34	31	3	77	7	41
		7	22	68	65	47	43	42	40	46	44				
12	04	3	77	60	63	40	40	35	26	35	32	3	77	10	47
		7	18	66	62	44	37	37	39	47	45				
13	05	7	26	61	67	47	41	38	36	41	38	3	76	7	39
		10	10	35	36	46	40	35	26	12	18				
14	06	7	34	56	73	50	45	40	33	35	31	3	76	7	38
		10	10	36	38	49	38	33	42	44	35				
15	07	7	48	59	66	43	39	33	15	23	20	3	73	10	35
		10	7	52	52	49	41	37	35	39	33				
16	08	10	5	68	66	49	45	41	29	34	32	3	70	14	45
		14	0	31	30	49	2	37	40	45	42				
17	09	10	18	65	60	35	35	28	4	14	14	7	68	14	39
		14	0	48	68	49	48	44	29	27	34				
18	10	10	32	62	62	35	37	35	12	17	18	7	73	14	33
		14	0	71	71	50	51	48	29	20	37				
19	11	10	47	60	61	33	36	35	12	24	24	7	72	14	36
		14	0	69	70	49	51	48	30	31	40				
20	12	10	43	58	60	32	36	35	14	32	30	7	71	14	39
		14	0	68	69	49	51	48	31	43	43				
21	13	10	41	59	60	40	42	40	25	36	34	7	72	21	31
		14	0	68	66	49	52	51	39	46	44				
22	14	10	40	60	60	49	48	45	37	41	39	7	73	21	58
		14	0	69	63	49	54	54	47	50	46				
23	15	7	72	54	59	43	40	37	28	33	26	7	72	21	51
		10	22	62	64	46	50	47	40	43	40				

ROCKY Teleport
Dec-Jan-Feb
SSN=5

Time UT	MS	Freqs	CISCO	APPLE	ANGEL	ALAMO	WINDY	LAKES	DIXIE	SWAMP	YANKS	Region Freqs	SN
00	17	7	60	58	61	58	59	55	46	50	46	3	72
		10	64	61	68	67	69	58	40	46	35		
01	18	7	61	57	63	61	64	56	46	47	38	3	74
		10	58	57	55	57	55	53	41	47	39		
02	19	3	53	56	56	54	59	51	36	42	37	3	75
		7	62	63	66	64	69	58	46	44	31		
03	20	3	55	56	58	55	58	51	37	45	39	3	77
		7	65	62	64	62	63	60	40	48	35		
04	21	3	59	56	61	56	57	52	38	48	42	3	77
		7	69	61	63	61	58	62	35	52	40		
05	22	3	59	56	62	57	57	52	38	47	40	3	77
		7	66	60	62	62	50	41	40	51	38		
06	23	3	60	57	63	58	58	53	38	46	39	3	77
		7	63	59	62	56	58	51	37	43	37		
07	00	3	60	56	62	56	58	51	37	43	37	3	77
		7	67	63	64	64	65	61	43	48	43		
08	01	3	60	56	62	55	59	50	36	41	36	3	77
		7	71	68	66	65	41	59	50	45	48		
09	02	3	58	57	60	54	60	51	36	42	37	3	77
		7	51	67	67	64	71	59	48	45	41		
10	03	3	57	58	59	54	61	52	36	44	39	3	77
		7	66	66	69	63	71	60	47	46	35		
11	04	3	58	57	61	54	60	52	35	44	37	3	77
		7	65	64	65	62	68	61	46	47	34		
12	05	3	60	57	63	55	60	53	34	44	35	3	76
		7	35	63	62	61	64	62	45	49	34		
13	06	7	67	65	67	61	64	57	42	47	36	3	76
		10	33	35	36	53	51	48	49	45	49		
14	07	7	69	67	73	61	64	53	39	45	39	3	73
		10	35	36	38	69	63	56	50	44	49		
15	08	7	63	50	66	50	57	46	26	39	29	3	70
		10	49	49	52	65	61	56	44	39	44		
16	09	10	63	62	66	61	60	56	38	34	40	7	68
		14	37	27	30	70	58	60	51	45	52		
17	10	10	62	61	60	60	61	52	36	34	38	7	73
		14	52	48	68	68	64	52	49	47	52		
18	11	10	61	60	62	60	62	49	34	35	37	7	72
		14	68	69	71	67	70	45	47	49	53		
19	12	10	59	59	61	60	61	52	35	41	41	7	71
		14	66	67	70	67	69	52	49	44	54		
20	13	10	57	59	60	60	60	56	37	48	46	7	72
		14	65	66	69	67	69	60	51	40	55		
21	14	10	58	60	60	61	61	57	37	48	46	7	73
		14	67	66	66	68	69	61	44	46	38		
22	15	10	60	61	60	62	63	58	49	54	51	7	72
		14	69	67	63	71	70	62	37	52	20		
23	16	7	54	55	59	57	58	53	42	47	44	7	72
		10	62	61	64	64	66	57	44	50	43		

Time UT	CS	Freqs	CISCO	APPEL	ANGLE	ROCKY	WINDY	LAKES	DIXIE	SWAMP	YANKS	Region Freqs	Region SN	ALAMO Teleport Dec-Jan-Feb SSN=5 Central America Freqs	Central America SN
00	18	7	44	45	48	58	62	61	61	53	51	3	79	(to be	
		10	52	53	43	67	63	63	62	63	48			determined	
01	19	7	45	45	43	61	64	64	62	56	47	3	77	when	
		10	45	46	48	57	51	53	53	56	48			Central	
02	20	3	33	36	38	54	61	58	55	52	43	3	76	America	
		7	46	46	39	64	67	68	64	59	44			teleport	
03	21	3	35	37	39	55	60	59	54	53	44	3	73	named)	
		7	36	40	41	62	64	65	62	61	47				
04	22	3	37	38	41	56	60	60	54	54	46	3	71		
		7	32	34	43	61	61	63	61	64	50				
05	23	3	37	39	41	57	60	59	54	53	45	3	72		
		7	34	36	44	62	62	64	63	62	48				
06	00	3	38	40	42	58	61	59	55	53	44	3	74		
		7	36	38	46	56	64	65	65	61	47				
07	01	3	37	38	41	56	60	57	54	41	43	3	75		
		7	42	42	44	64	67	65	64	59	46				
08	02	3	37	37	41	55	60	56	54	50	43	3	76		
		7	49	47	43	65	70	65	64	58	45				
09	03	3	36	37	41	54	61	57	53	51	43	3	76		
		7	49	48	46	64	71	66	63	59	46				
10	04	3	36	38	41	54	61	59	52	51	41	3	77		
		7	49	49	50	63	72	67	63	60	47				
11	05	3	36	39	40	54	61	59	52	51	41	3	77		
		7	41	43	47	62	69	69	63	59	44				
12	06	3	37	40	40	55	61	60	51	50	38	3	78		
		7	34	37	44	61	67	72	63	59	42				
13	07	7	39	41	47	61	63	65	60	54	41	3	76		
		10	39	40	46	53	52	49	47	54	54				
14	08	7	45	45	50	61	60	59	58	50	41	3	74		
		10	38	38	49	69	68	65	64	60	52				
15	09	7	38	39	43	50	50	49	48	43	28	3	73		
		10	41	41	49	65	65	63	62	55	44				
16	10	10	44	45	49	61	62	62	61	51	37	3	80		
		14	15	2	49	70	71	69	68	52	49				
17	11	10	39	35	35	60	61	61	60	50	39	7	79		
		14	32	48	49	68	70	68	69	58	47				
18	12	10	35	37	35	60	61	60	60	49	42	7	79		
		14	50	51	50	67	69	68	70	64	46				
19	13	10	35	36	33	60	60	60	61	53	46	7	80		
		14	49	51	49	67	69	68	69	63	42				
20	14	10	35	36	32	60	60	61	62	47	48	7	82		
		14	48	51	49	67	70	69	69	63	38				
21	15	10	40	42	40	61	62	62	63	57	51	7	79		
		14	50	52	49	68	64	65	66	65	45				
22	16	10	45	48	49	62	65	64	64	58	55	7	77		
		14	52	54	49	71	58	61	64	67	53				
23	17	7	38	40	43	57	61	60	60	54	49	7	78		
		10	48	50	46	64	64	63	63	60	51				

WINDY Teleport
Dec-Jan-Feb
SSN=5

Time UT	CS	Freqs	CISCO	APPLE	ANGEL	ROCKY	ALAMO	LAKES	DIXIE	SWAMP	YANKS	Region Freqs	SN
00	18	7	44	46	45	59	62	57	53	73	69	3	79
		10	51	52	53	69	63	10	57	45	58		
01	19	7	44	45	45	64	64	51	53	63	66	3	77
		10	42	49	46	55	51	10	53	46	51		
02	20	3	33	34	36	59	61	76	48	67	60	3	76
		7	44	44	46	69	67	45	54	54	63		
03	21	3	35	36	37	58	60	73	48	66	59	3	73
		7	36	40	40	63	64	44	55	52	60		
04	22	3	37	39	38	57	60	71	49	66	59	3	71
		7	29	37	34	58	61	44	57	50	57		
05	23	3	38	39	39	57	60	72	48	66	59	3	72
		7	31	39	36	50	62	39	56	52	60		
06	00	3	40	40	40	58	61	74	48	66	60	3	74
		7	34	41	38	58	64	35	56	54	64		
07	01	3	38	35	38	58	60	75	47	66	61	3	75
		7	41	37	42	65	67	28	64	66	65		
08	02	3	36	35	37	59	60	76	46	67	62	3	76
		7	48	34	47	41	70	22	63	57	67		
09	03	3	36	35	35	60	61	76	46	67	62	3	76
		7	48	40	48	71	71	23	53	54	64		
10	04	3	37	36	38	61	61	77	46	68	62	3	77
		7	48	47	49	71	72	24	53	52	62		
11	05	3	43	38	39	60	61	77	44	67	60	3	77
		7	40	43	43	68	69	31	52	52	66		
12	06	3	39	40	40	60	61	78	42	67	59	3	78
		7	32	40	37	64	67	38	51	53	71		
13	07	7	37	42	41	64	63	52	48	63	64	3	76
		10	37	41	40	51	52	10	57	54	53		
14	08	7	43	44	45	64	60	67	46	73	57	3	74
		10	34	41	38	63	68	9	55	65	64		
15	09	7	34	17	39	57	50	73	39	67	52	3	73
		10	39	44	41	61	65	17	52	68	63		
16	10	10	44	47	45	60	62	26	50	71	62	3	80
		14	0	42	2	58	71	0	53	22	72		
17	11	10	41	0	35	61	61	33	49	70	60	7	79
		14	25	47	48	64	70	1	49	27	71		
18	12	10	38	39	37	62	61	40	48	69	59	7	79
		14	51	52	51	70	69	2	46	32	71		
19	13	10	37	38	36	61	60	38	51	70	63	7	80
		14	50	52	51	69	69	2	52	23	67		
20	14	10	36	38	36	60	60	36	55	72	68	7	82
		14	50	53	51	69	70	4	59	15	63		
21	15	10	41	44	42	61	62	22	56	58	67	7	79
		14	52	47	52	69	64	4	60	5	45		
22	16	10	47	50	48	63	65	9	57	45	67	7	77
		14	55	40	54	70	58	5	62	0	28		
23	17	7	39	43	40	58	61	67	52	73	65	7	78
		10	48	51	50	66	64	9	57	45	62		

LAKES Teleport
Dec-Jan-Feb
SSN=5

Time UT	CS	Freqs	CISCO	APPLE	ANGEL	ROCKY	ALAMO	WINDY	DIXIE	SWAMP	YANKS	Region Freqs	SN
00	19	7	41	43	43	55	61	57	57	53	72	3	79
		10	48	50	50	58	63	10	60	9	46		
01	20	7	38	46	43	56	64	51	59	48	63	3	77
		10	30	29	25	53	53	10	52	9	47		
02	21	3	35	37	31	51	58	76	54	76	67	3	76
		7	46	49	43	58	68	45	62	43	55		
03	22	3	37	35	32	51	59	73	54	75	66	3	73
		7	47	37	38	60	65	44	61	41	53		
04	23	3	40	33	34	52	60	71	54	72	66	3	71
		7	48	26	34	62	63	44	60	40	51		
05	00	3	37	33	34	52	59	72	53	73	66	3	72
		7	41	28	34	41	64	39	61	33	54		
06	01	3	34	34	35	53	59	74	53	75	67	3	74
		7	35	30	35	51	65	35	62	27	58		
07	02	3	36	32	34	51	57	75	52	75	67	3	75
		7	43	37	41	61	65	28	61	24	57		
08	03	3	39	31	34	50	56	76	51	76	68	3	76
		7	52	44	47	59	65	22	61	22	56		
09	04	3	39	16	35	51	57	76	51	76	67	3	76
		7	51	16	47	59	66	23	60	20	53		
10	05	3	39	2	36	52	59	77	51	76	67	3	77
		7	50	0	47	60	67	24	60	18	51		
11	06	3	36	1	35	52	59	77	49	76	66	3	77
		7	47	0	42	61	69	31	58	25	58		
12	07	3	34	1	35	53	60	78	47	77	66	3	78
		7	45	0	37	62	72	38	57	32	65		
13	08	7	43	19	38	57	65	52	53	53	66	3	76
		10	36	7	35	48	49	10	56	11	58		
14	09	7	42	37	40	53	59	67	49	75	68	3	74
		10	32	16	33	56	65	9	61	12	73		
15	10	7	16	7	33	46	49	73	42	77	64	3	73
		10	36	28	37	56	63	17	55	24	72		
16	11	10	41	40	41	56	62	26	49	36	71	3	80
		14	49	23	37	60	69	0	66	0	37		
17	12	10	38	0	28	52	61	33	52	40	71	7	79
		14	48	37	44	52	68	1	66	0	39		
18	13	10	35	38	35	49	60	40	56	44	72	7	79
		14	47	51	48	45	68	2	67	0	41		
19	14	10	35	38	35	52	60	38	57	68	71	7	80
		14	47	51	48	52	68	2	67	0	30		
20	15	10	35	38	35	56	61	36	58	66	71	7	82
		14	47	51	48	60	69	4	67	2	19		
21	16	10	39	43	40	57	62	22	59	21	71	7	79
		14	50	52	51	61	65	4	68	2	0		
22	17	10	43	47	45	58	64	9	61	9	66	7	77
		14	53	54	54	62	61	5	70	3	0		
23	18	7	35	40	37	53	60	67	57	61	72	7	78
		10	45	48	47	57	63	9	60	9	56		

DIXIE Teleport
Dec-Jan-Feb
SSN=5

Time UT	PS	Freqs	CISCO	APPLE	ANGEL	ROCKY	ALAMO	WINDY	LAKES	SWAMP	YANKS	Region Freqs	Region SN	Caribbean Freqs	Caribbean SN
00	19	7	33	33	7	46	61	53	57	60	48	3	75	10	54
		10	43	43	43	40	62	57	60	59	59				
01	20	7	27	34	38	46	62	53	59	62	50	3	74	7	62
		10	36	56	35	41	53	53	52	49	53				
02	21	3	22	24	25	36	55	48	54	61	48	3	74	7	62
		7	37	36	39	46	64	54	62	65	53				
03	22	3	24	37	27	37	54	48	54	61	49	3	74	7	62
		7	37	37	40	40	62	55	61	62	54				
04	23	3	27	30	29	38	54	49	54	61	50	3	74	7	63
		7	38	39	41	35	61	57	60	60	56				
05	00	3	27	29	29	38	54	48	53	61	48	3	74	7	63
		7	39	41	42	40	63	56	61	62	54				
06	01	3	28	28	30	38	55	48	53	61	47	3	74	7	63
		7	41	43	44	37	65	56	62	64	53				
07	02	3	27	25	29	37	54	47	52	61	47	3	74	7	63
		7	41	41	44	43	64	64	61	63	53				
08	03	3	26	22	28	36	54	46	51	61	47	3	75	7	64
		7	42	40	44	50	64	63	61	63	53				
09	04	3	25	22	28	36	53	46	51	60	47	3	75	7	63
		7	41	39	43	48	63	53	60	63	53				
10	05	3	25	22	28	36	52	46	51	60	47	3	75	7	62
		7	41	39	42	47	63	53	60	64	53				
11	06	3	24	23	27	35	52	44	49	57	42	3	74	7	61
		7	39	39	40	46	63	52	58	62	53				
12	07	3	24	25	26	34	51	42	47	55	37	3	73	10	67
		7	37	43	39	45	63	51	57	60	53				
13	08	7	33	34	36	42	60	48	53	58	47	7	63	10	63
		10	18	20	26	49	47	57	56	59	55				
14	09	7	30	28	33	39	58	46	49	57	41	7	79	14	76
		10	38	36	42	50	64	55	61	63	54				
15	10	7	23	0	15	26	48	39	42	50	26	7	79	14	69
		10	32	32	35	44	62	52	55	50	43				
16	11	10	27	27	29	38	61	50	49	37	32	7	79	14	52
		14	37	37	40	51	68	53	66	66	53				
17	12	10	19	0	4	36	60	49	52	48	40	7	77	14	60
		14	35	36	29	49	69	49	66	67	50				
18	13	10	12	15	12	34	60	48	56	59	49	7	76	14	69
		14	33	36	29	47	70	46	67	69	48				
19	14	10	13	17	12	35	61	51	57	54	48	7	88	14	70
		14	33	37	30	49	69	52	67	68	54				
20	15	10	15	19	14	37	62	55	58	61	56	7	81	14	72
		14	34	38	31	51	69	59	67	69	59				
21	16	10	24	28	25	37	63	56	59	62	55	7	81	14	75
		14	39	42	39	44	66	60	68	64	60				
22	17	10	34	36	37	49	64	57	61	63	55	7	82	14	79
		14	44	46	47	37	64	62	70	60	62				
23	18	7	24	26	28	42	60	52	57	62	50	3	74	10	59
		10	38	39	40	44	63	57	60	61	57				

SWAMP Teleport
Dec-Jan-Feb
SSN=5

Time UT	PS	Freqs	CISCO	APPLE	ANGEL	ROCKY	ALAMO	WINDY	LAKES	DIXIE	YANKS	Region Freqs	SN
00	19	7	37	39	39	50	53	73	53	60	58	3	75
		10	44	45	45	46	63	45	9	59	18		
01	20	7	32	41	40	47	56	63	48	62	55	3	74
		10	32	29	30	47	56	46	9	49	24		
02	21	3	28	31	30	42	52	67	76	61	74	3	74
		7	40	43	41	44	59	54	43	65	53		
03	22	3	32	32	32	45	53	66	75	61	74	3	74
		7	42	39	42	48	61	52	41	62	52		
04	23	3	36	34	35	48	54	66	72	61	74	3	74
		7	44	36	44	52	64	50	40	60	51		
05	00	3	36	33	36	47	53	66	73	61	74	3	74
		7	45	40	46	51	62	52	33	62	49		
06	01	3	36	33	37	46	53	66	75	61	74	3	74
		7	47	44	48	43	61	54	27	64	47		
07	02	3	33	32	35	43	41	66	75	61	74	3	74
		7	46	45	47	48	59	66	24	63	43		
08	03	3	31	32	33	41	50	67	76	61	75	3	75
		7	45	47	46	45	58	57	22	63	40		
09	04	3	32	33	33	42	51	67	76	60	75	3	75
		7	44	47	45	45	59	54	20	63	41		
10	05	3	33	34	33	44	51	68	76	60	75	3	75
		7	44	47	45	46	60	52	18	64	42		
11	06	3	34	33	34	44	51	67	76	57	74	3	74
		7	45	46	46	47	59	52	25	62	45		
12	07	3	35	32	35	44	50	67	77	55	73	3	73
		7	47	46	47	49	59	53	32	60	48		
13	08	7	40	41	41	47	54	63	53	58	63	7	63
		10	15	40	12	45	54	54	11	59	26		
14	09	7	34	35	35	45	50	73	75	57	79	7	79
		10	43	43	44	44	60	65	12	63	47		
15	10	7	23	0	23	39	43	67	77	50	79	7	79
		10	38	39	39	39	55	68	24	50	55		
16	11	10	33	35	34	34	51	71	36	37	64	7	79
		14	44	45	45	45	2	422	0	66	0		
17	12	10	42	0	14	34	50	70	40	48	64	7	77
		14	39	44	27	47	58	27	0	67	0		
18	13	10	18	33	17	35	49	69	44	59	65	7	76
		14	34	44	20	49	64	32	0	69	0		
19	14	10	23	34	24	41	53	70	68	54	59	7	88
		14	38	45	31	44	63	23	0	68	0		
20	15	10	29	35	32	48	47	72	66	61	54	7	81
		14	43	46	43	40	63	15	2	69	0		
21	16	10	31	39	36	48	57	58	21	62	32	7	81
		14	45	49	46	46	65	5	2	64	0		
22	17	10	39	43	41	54	58	45	9	63	10	7	82
		14	48	51	50	52	67	0	3	60	0		
23	18	7	31	35	33	47	54	73	61	62	73	3	74
		10	41	44	43	50	60	45	9	61	65		

YANKS Teleport
Dec-Jan-Feb
SSN=5

Time UT	PS	Freqs	CISCO	APPLE	ANGLE	ROCKY	ALAMO	WINDY	LAKES	DIXIE	SWAMP	Region Freqs	Region SN	W Europe Freqs	W Europe SN
00	19	7	35	37	37	46	51	69	72	48	58	3	75	7	42
		10	43	43	42	35	48	58	46	59	18				
01	20	7	30	38	37	38	47	66	63	50	55	3	74	7	40
		10	32	28	31	39	48	51	47	53	24				
02	21	3	25	26	27	37	43	60	67	48	74	3	74	7	39
		7	37	39	38	31	44	63	55	53	53				
03	22	3	29	29	30	39	44	59	66	49	74	3	74	7	42
		7	39	40	40	35	47	60	53	54	52				
04	23	3	34	32	34	42	46	59	66	50	74	3	74	7	45
		7	42	41	43	40	50	57	51	56	51				
05	00	3	34	31	34	40	45	59	66	48	74	3	74	7	36
		7	43	42	45	38	48	60	54	54	49				
06	01	3	34	31	35	39	44	60	67	47	74	3	74	7	27
		7	45	43	47	37	47	64	58	53	47				
07	02	3	32	30	32	37	43	61	67	47	74	3	74	7	28
		7	43	43	45	43	46	65	57	53	43				
08	03	3	30	29	30	36	43	62	68	47	75	3	75	7	29
		7	42	44	44	48	45	67	56	53	40				
09	04	3	28	29	30	37	43	62	67	47	75	3	75	7	30
		7	41	43	43	41	46	64	53	53	41				
10	05	3	26	29	30	39	41	62	67	47	75	3	75	7	31
		7	41	43	43	35	47	62	51	53	42				
11	06	3	28	28	31	37	41	60	66	42	74	3	74	10	25
		7	42	43	44	34	44	66	58	53	45				
12	07	3	31	27	32	35	38	59	66	37	73	3	73	10	36
		7	44	43	45	34	42	71	65	53	48				
13	08	7	37	36	38	36	41	64	66	47	63	7	63	10	35
		10	18	34	18	49	54	53	58	55	26				
14	09	7	30	29	31	39	41	57	68	41	79	7	79	14	56
		10	38	38	35	49	52	64	73	54	47				
15	10	7	20	0	20	29	28	52	64	26	79	7	79	14	56
		10	34	36	33	44	44	63	72	43	55				
16	11	10	30	35	32	40	37	62	71	32	64	7	79	14	57
		14	40	45	42	52	9	72	37	53	0				
17	12	10	25	0	14	38	39	60	71	40	64	7	77	10	36
		14	39	43	34	52	47	71	39	50	0				
18	13	10	20	30	18	37	42	59	72	49	65	7	76	10	41
		14	38	42	37	53	46	71	41	48	0				
19	14	10	25	33	24	41	46	63	71	48	59	7	88	7	30
		14	40	44	40	54	42	67	30	54	0				
20	15	10	30	36	30	46	48	68	71	56	54	7	81	7	40
		14	43	46	43	55	38	63	19	59	0				
21	16	10	34	39	34	46	51	67	71	55	32	7	81	7	39
		14	44	47	44	38	45	45	0	60	0				
22	17	10	38	41	39	51	55	67	66	55	10	7	82	7	39
		14	46	49	46	20	53	28	0	62	0				
23	18	7	25	32	26	44	49	65	72	50	73	3	74	7	40
		10	40	42	40	43	51	62	56	57	65				

ANNEX B

TELEPORT STATION LIST

Mailing Address	Coordinates & Grid	Suggested Assignment
Donald Stiver N6EEG 1649 Roger Ct El Cerrito CA 94530	37.54N 122.18W CM87 (H) 415-233-5846 (W) 415-486-5088	CISCO teleport
Donald Simon NI6A/W6CUS-1 2327 Alva Ave El Cerrito CA 94530	37.54N 122.18W CM87 (H) 415-237-1381 (W) 415-237-1381	CISCO teleport
Hank Oredson WØRLI 134 Ponderosa Dr Santa Cruz CA 95060	36.58N 122.01W CM86 (H) (W)	CISCO teleport
Thomas J Hogan WB7DCH 26911 SE 456th St Enumclaw WA 98022	47.12N 121.59W CN97 (H) 206-825-3019 (W) 206-657-6518	APPLE teleport
Mike Lamb N7ML 16517-73rd Ave SE Snohomish WA 98920	47.82N 122.07W CN87 (H) (W) 206-775-7373	APPLE teleport
Lee Dusbabek WB6KAJ 1823 W Lotus Pl Brea CA 92621	33.55N 117.53W DM13 (H) (W)	ANGEL teleport
John J. Eigenbrode KD6SQ 7871 Montara Ave Rancho Cucamonga CA 91730	34.06N 117.35W DM14 (H) 714-987-0975 (W)	ANGEL teleport
Dave Shavey KØHOA 4745 Nightingale Dr Colorado Springs CO 80907	38.50N 104.49W DM78 (H) 303-598-1508 (W) 303-634-3742	ROCKY teleport
David Freeborn KCØQJ 297 Vega Rd Walsenburg CO 81089	37.37N 104.46W DM77 (H) 303-738-2740 (W) retired	ROCKY teleport
Charles A Lee Jr WA4EWV 6515 Glenhill Dr Spring TX 77389	29.45N 95.21W EL29 (H) 713-376-7312 (W)	ALAMO teleport
Walter Holmes Jr WD5GAZ 11726 Henley Dr Houston TX 77064	29.45N 95.21W EL29 (H) 713-955-1351 (W) 713-374-1329	ALAMO teleport
Dennis N Ely W5XO Box 418 Gause TX 77857	30.47N 96.43W EM10 (H) 409-279-3924 (W)	ALAMO teleport

Gregg R Lengling WD9DHI N60 W6667 Victoria Ct Cedarburg WI 53012	43.17N 87.59W EN63 (H) 414-375-1231 (W) 414-375-2988	WINDY teleport
Gary F Kaatz W9TD 125 Forest Park Ln Hoffman Estates IL 60194	42.02N 88.04W EN51 (H) 312-885-7713 (W) 312-576-7715	WINDY teleport
David L Zeph W9ZRX 16310 Spring Mill Rd Westfield IN 46074	40.02N 86.07W EN60 (H) 317-896-3876 (W) 317-353-7961	WINDY skylight
Joseph T Subich AD8I 7825 State Rt 188 Circleville OH 43113	39.36N 82.56W EM89 (H) 614-477-1373 (0000-0300Z) (W) 614-895-2800	LAKES teleport
Joseph E Galipeau Jr WA1LRL 11200 Young Dr Brighton MI 48116-9250	42.31N 83.46W EN82 (H) 313-229-4488 (W) 313-995-6367	LAKES teleport
Fred Sole WB8LVP 2150 Manor Ave Poland OH 44514	41.01N 80.37W EN91 (H) 216-755-5074 (W) 216-742-3744	LAKES teleport
Neal S Wood Jr KØKBY 4775 Pine Dr Miami FL 33143	25.46N 80.11W EL95 (H) 305-667-8921 (W)	DIXIE teleport
Theodore A Huff K4NTA 1829 NW Pine Tree Way Stuart FL 33494	27.11N 80.15W EL97 (H) 305-692-0728 (W) 305-842-5261 X324	DIXIE teleport
James E Scalf K4TKU 10045 SW 70th Ave Miami FL 33156	25.46N 80.11W EL95 (H) 305-667-3410 (W) 305-552-3840	DIXIE teleport
Franklin W McPherson KB7TV 5220 Benjamin Ave Boynton Beach FL 33437	26.31N 80.04W EL96 (H) 305-737-2823 (W) 305-982-6543	DIXIE teleport
Joseph A Fisher KC2TN 33 Oakwood La Atco NJ 08004	39.46N 74.53W FM29 (H) 609-768-0822 (W) 609-772-9956	SWAMP teleport or skylight?
Dr Thomas A Clark W3IWI 6388 Guilford Rd Clarksvile MD 21029	39.12N 76.56W FM19me (H) 301-854-3113 (W) 301-286-5957	SWAMP teleport
Jack Colson W3TMZ 5609 Old Oak Dr Mount Airy MD 21771	39.41N 77.12W FM19 (H) 301-831-7086 (W) 301-953-6410	SWAMP teleport
Carl C Nemec K3VPZ 9309 Old Court Rd Baltimore MD 21207	39.21N 76.51W FM19 (H) 301-521-2040 (W) 301-765-6374	SWAMP teleport

David W Borden K8MMO 10808 Mantilla Ct Oakton VA 22124	38.86N 77.35W FM18 (H) 703-938-3724 (W) 301-459-8655	SWAMP teleport
Karl H Geng N1DL 88 East Shore Rd Huntington Bay LI NY 11743	40.97N 73.38W FN30 (H) (W)	YANKS teleport position to Europe?
Herbert H Salls WB1DSW 122 Giles Rd RFD #1 East Kingston NH 03827	42.99N 71.01 FN42 (H) (W)	YANKS teleport
Joseph P Demers WA1WLV 378 Market St Lawrence MA 01843	42.42N 71.09W FN42 (H) (W)	YANKS teleport
Donald J S Merten K2AAA PO Box 309 Montauk NY 11954	41.04N 71.52W FN41 (H) 516-668-5904 (W) 516-668-5904	YANKS teleport
William R Michalson AA2S RFD 1 Box 281 Southbridge MA 01550	42.08N 71.58W FN41 (H) (W)	YANKS teleport

ANNEX C

SKYLIGHT STATION LIST

Mailing Address	Coordinates & Grid	Suggested Assignment
Donald W O'Neil WA4SZK 900 Beverly Dr Florence SC 29501	34.11N 79.45W FM04 (H) 803-662-1842 (W) 803-669-7753	skylight for SC
John Thomas Smith KI4XO 2449 Old Forge Ct Marietta GA 30062	33.57N 84.33W EM73 (H) 404-641-1576 (W) 404-239-5252	skylight for GA
Robert Thanisch KN5D PO Box 997 Corrales NM 87048	35.27N 106.67W DM65 (H) 505-898-3859 (W)	skylight for NM
Wesley F Morris K7PYK 7422 E McKinley St Scottsdale AZ 85257	33.30N 111.53W DM43 (H) 602-947-0362 (H) 602-946-8356 machine	skylight for AZ
William A Schroeder W9ZBD 4247 Forest Point Dr Rhinelander WI 54501	45.38N 89.24W EN55 (H) 715-369-1215 (W) 715-362-5157	skylight for WI
Robert A Schiers Jr NØAN PO Box 171 Ames IA 50010	42.13N 93.31W EN32 (H) 515-434-2368 (W) 515-232-8405	skylight for IA
David C Fitz KIØQ 1124 Roosevelt Ave Ames IA 50010	42.02N 93.37W EN32 (H) (W)	skylight FOR IA
Fred Scalf Jr K4EID 4813 Palmstone Ln Knoxville TN 37918	35.57N 83.55W EM85 (H) 615-922-1906 (W) 615-922-1906	skylight for TN

SUMMARY OF REPONSES FROM HF GATEWAY OPERATORS 12/4/86

Call Sign	Dig Ctrl	Radio Equipment	Freq Recs	Like Plan	Want STA	Have 800	Will 600	Frequency Coverage
N1DL	Yes	IC-720A IC-751	Yes	Yes	Yes	No	Yes	14105 24h; 14107 if traffic
WB1DSW	No	TS-830S	Yes	--	Yes	No	Yes	14107 day; 7093 night
W1LRL	No	FT-901	Yes	Yes	Yes	No	Yes	14109
W1WLV	Yes	TS-430S	Yes	Yes	Yes	No	Yes	14109
K2AAA	Yes	DigiScan	Yes	Yes	Yes	Yes	Yes	14109/7093 & AMTOR
AA2S	Yes	IC-751	Yes	Yes	Yes	Yes	Yes	Off; on about Dec 1
KC2TN	No	Drake TR7	Yes	Yes	Yes	No	Yes	14107 2100-0900Z
W3IWI	Yes	TS-940	Yes	Yes	Yes	No	Yes	14109 eves/weekends
W3TMZ	No	IC-720A	Yes	Yes	No	No	Yes	14105 24h
K3VPZ	Yes	TS-930S	Yes	Yes	Yes	No	Yes	14107 24h for STA
K4EID	No	TS-930S	Yes	Yes	No	Yes	Yes	14107 24h; 7093 occasionally
WA4EWV	No	Drake TR7	Yes	Yes	Yes	No	Yes	14107 when active
K4NTA	No	TS-430S	Yes	Yes	Yes	No	Yes	14107
WA4SZK	No	TS-830S	Yes	Yes	Yes	No	Yes	14107 0700-0830, 1700-2400 weekdays; 0700-2400 Eastern weekends
K4TKU	Yes	TS-440S	Yes	Yes	Yes	Yes	Yes	14107 1730-0700 Eastern; 7093 when 20 m out
KI4XO	Yes	FT-757GX	No	Yes	Yes	Yes	Yes	14107, 10147, 7093
KN5D	No	FT-ONE	Yes	Yes	Yes	Yes	Yes	14107; 7093 when 20 m out
WD5GAZ	Yes	IC-701	Yes	Yes	Yes	Yes	Yes	14107 24h
W5XO	No	IC-751	Yes	Yes	Yes	No	Yes	14107 days when home; 7093 nites
WA6CUS	Yes	IC-735	Yes	Yes	Yes	No	Yes	7093 24h
N6EEG	Yes	TS-430	Yes	Yes	Yes	No	Yes	14107; 7093 when 20 m out
WB6KAJ	Yes	FT-757	Yes	Yes	Yes	Yes	Yes	14103 24h
KD6SQ	No	TS-430S	Yes	--	Yes	No	Yes	14107 24h; 7093 occasionally
WB7DCH	Yes	IC-735	Yes	Yes	Yes	No	Yes	14107 24h
N7ML	Yes	IC-745/751	Yes	Yes	Yes	Yes	Yes	Can guard any HF channel anytime
K7PYK	Yes	TS-980	Yes	Yes	Yes	--	--	14107 24h, 7093, 10149.6
KB7TV	No	TS-930S	Yes	Yes	Yes	Yes	--	14107 when not working
AD8I	Yes	TS-940	Yes	Yes	Yes	Yes	Yes	14107 24h; 7093 0000-1130Z winter
WB8LVP	Yes	IC-740 or IC-745	Yes	Yes	Yes	No	Yes	14107 day; 7093 eves
K8MMO	Yes	FT-101ZD FT-757	Yes	Yes	Yes	Yes	Yes	14107 1900-2300 Eastern
WD9DHI	Yes	IC-730	Yes	Yes	Yes	Yes	Yes	14107 1200-0200Z, 7093 0200-1200Z
W9TD	Yes	IC-751	No*	Yes	Yes	No	Yes	14107 weekends
W9ZBD	Yes	TS-940S	Yes	Yes	Yes	No	Yes	14103 or 14107 days; 7093 eves
W9ZRX	Xtal	Drake TR7	Yes	Yes*	Yes	--	Yes	14107 1300-2300Z, 7093 2300-1300Z
N0AN	Yes	TS-940S	Yes	Yes	Yes	No	Yes	14107 M-F 1600-0700, 24h weekends; 7093 when 20 m out
K0HOA	No	IC-740	Yes	Yes	Yes	No	Yes	14107 when home
K0KBY	No	IC-751	Yes	Yes	Yes	Yes	Yes	14107 24h
KI0Q	No	TS-180S	Yes	Yes	--	No	--	14107, 7093
KC0QJ	Yes	IC-745	Yes	Yes	Yes	No	Yes	14107 24h when home
W0RLI	No	TS-930S	Yes	Yes	Yes	No	Yes	14107; 7093 when 20 m out

*W9TD disagrees with 7096 because of splatter from International BC.
W9ZRX disagrees with exclusion of AD8I and W9ZRX.

THE AMERICAN RADIO RELAY LEAGUE, INC.
ADMINISTRATIVE HEADQUARTERS: NEWINGTON, CONNECTICUT

LARRY E. PRICE
JAY L. HOLLADAY
LEONARD M. NATHANSON
FRED OLSON
DAVID SUMNER
PETER WILLIAMS
JAMES E. McCUNE
K1LLU, TREASURER

November 5, 1986

PACKET RADIO MANUFACTURERS

Gentlemen:

Are your products available to hams in Latin America?

International Affairs Vice President Tod Olson, KØTO, (Digital Committee Board Liaison) was recently in Buenos Aires to attend International Amateur Radio Union conferences. Packet radio and its development in Latin America came up in discussions several times. There is interest in packet radio, but it also became clear that there is an equipment-availability problem.

Among other things, Tod learned that a 2-meter packet net is now active in the Caribbean and northern-tier countries of South America.

We are aware that there are difficulties involved in exporting to some Latin American countries. Nevertheless, maybe you can find a way to sell there and to create a little more visibility for your products in those markets.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

cc: Digital Committee

F L A S H

Report No. DC-645 ACTION IN DOCKET CASE October 9, 1986

FCC AUTHORIZES AUTOMATIC CONTROL FOR CERTAIN AMATEUR STATIONS WHEN RETRANSMITTING THIRD-PARTY TRAFFIC (PR DOCKET 85-105)

The Commission has amended Part 97 permitting network intermediate amateur stations, transmitting digital communications on VHF and above, using the American Radio Relay League, Inc. (ARRL) AX.25 packet protocol, to be operated under automatic control while retransmitting third-party traffic.

Packet is a specialized form of digital communications, relatively new to amateur radio, consisting of numerous amateur stations using personal computers and associated circuitry retransmitting messages from originating stations to destination stations.

Although it acknowledged assurances of safeguards by the ARRL for the AX.25 packet protocol, the FCC noted that control operators capable of monitoring such transmissions must alert the control operator of any intermediate retransmitting station, under automatic control, of any station misuse so that corrective action can be taken.

The Commission deferred action on requests for automatic control for digital communications on frequencies below VHF until its feasibility can be determined.

Action by the Commission October 6, 1986, by Memorandum Opinion and Order (FCC 86-427). Commissioners Fowler (Chairman), Quello, Dawson, and Patrick, with Commissioner Dennis not participating.

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Before the
Federal Communications Commission
Washington, D.C. 20554

PR Docket No. 85-105

In the Matter of

Amendment of Part 97 of the Commission's Rules to permit automatic control of amateur radio stations.

MEMORANDUM OPINION AND ORDER

Adopted: October 6, 1986 ; Released: October 16, 1986

By the Commission: Commissioner Dennis not participating.

Background

1. On January 13, 1986, we adopted a Report and Order (51 FR 3069; January 23, 1986) authorizing amateur stations transmitting digital communications on VHF and above to be operated under automatic control. We affirmed the general requirement that the station control operator be present at the station control point of any amateur station transmitting third-party traffic. Twenty-one petitions seeking full or partial reconsideration of our action have been filed.[1] The Chief, Private Radio Bureau subsequently granted a Petition for Extraordinary Relief filed by the American Radio Relay League, Inc. (ARRL) which excepts from the general requirement intermediate retransmitting stations in a network using the ARRL AX.25[2] packet protocol allowing them to be operated under automatic control while retransmitting third-party traffic. The waiver will expire concomitant with our action on the petitions for reconsideration.

2. Packet is a specialized form of digital communications relatively new to amateur radio. A packet network consists of numerous amateur stations using personal computers and associated circuitry retransmitting messages from originating stations to destination stations. It usually incorporates electronic mailbox and bulletin board capabilities. Messages are retransmitted through the network at high speeds in "packets" or fragments and are reconstituted at the destination stations.

The Petitions

3. The first issue concerns automatic control of amateur stations transmitting digital communications on amateur frequencies below VHF. We did not authorize such operation because of the greater possibility of congestion than on VHF and above. Williams, Miller, Simon, Fish, Struven, Dickson, and Smith request reconsideration of this issue. ARRL filed a partial opposition to these petitions. ARRL states such an authorization would be premature while operating standards are still evolving. It plans to coordinate a small group of packet radio enthusiasts, not limited to ARRL members, to request special temporary authorization to determine the feasibility of such operation.

4. The second issue concerns the exception for ARRL AX.25 packet protocol network intermediate retransmitting stations from the requirement for the station control operator to supervise personally all of the station transmissions containing third-party traffic. The thrust of the petitions was that in this instance such control is neither necessary or practicable. ARRL states:

> The question of risk vs. benefit in considering manual control throughout an amateur packet-network while handling third-party traffic should be resolved in favor of the benefit of the efficient functioning of the network. In the opinion of the League, the widespread public benefit of having a high-speed packet-radio network with the capacity of handling major emergencies far outweighs the narrow risk of unsupervised use of the network by unlicensed persons.

5. The principal suggestion advanced as a safeguard against unauthorized use was to require the presence of the control operator of the originating station – where messages are introduced into the packet network – at the station control point. That station control operator can detect and screen improper messages from entry into the network. Clark states that it is not feasible to check the message content at intermediate points in a packet network due to the high transmission speed and message fragmentation. ARRL states that since packets are in the order originated only at the entry point, it is the only point where the control operator requirement should be applied.

6. ARRL believes other safeguards exist in its AX.25 packet protocol. Detailed records of message transfers and histories of who accessed them are automatically maintained. All messages include serial number together with the originating station call sign, making it possible to establish a trail of accountability. Periodic reviews of these records by control operators together with monitoring by other amateur operators will detect improper usage. The ARRL states that future digital systems will inevitably use even more sophisticated logging procedures because they will be essential for proper overall network management.

Discussion

7. The matter of automatic control of amateur stations transmitting digital communications below VHF would be better addressed upon conclusion of feasibility investigations. However, the matter of unsupervised retransmission of third-party traffic goes to the fundamental purpose of the service:

> A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.[3]

Our rules for the Amateur service limit the use of amateur frequencies to licensed operators, and they preclude the use of the frequencies for pecuniary interest. Unless amateur stations which retransmit messages employ adequate safeguards, undetected use by non-amateurs of amateur frequencies is possible. Should this occur, the legitimacy of the service would be imperiled.

8. When an amateur station is under local or remote control, the control operator at the control point directly supervises every transmission. Thus, all transmitted messages are screened. Such is not the case where the station is operated under automatic control.[4]

Only after-the-fact screening is possible since the control operator can only indirectly supervise the station transmissions.[5] For this reason, our rules prohibit the transmission of third-party traffic from any amateur station under automatic control. While screening of messages at the entry point serves to prevent the introduction of improper messages into an ARRL AX.25 packet protocol network by amateur stations, it remains for monitoring by other amateur operators to detect the introduction of messages from non-amateur stations. According to the petitioners, the nature of the ARRL AX.25 packet protocol is such that control operators of intermediate retransmitting stations are unable to fully screen retransmitted messages. Thus the packet network is vulnerable to unauthorized use. The design of future retransmitting networks should take these matters into account more fully.[6]

Decision

9. With respect to the matter of authorizing automatic control of amateur stations transmitting digital communications below VHF, we will defer further consideration of such expansion. Organized feasibility projects conducted by a manageable group of amateur stations such as that planned by ARRL will be helpful in determining any rules necessary to prevent interference to and from other amateur operations.

10. With respect to the matter of automatic control of intermediate retransmitting stations, we acknowledge the safeguard assurances by the petitioners for the ARRL AX.25 packet protcol. The exception provided by the temporary waiver is incorporated into the rules. As in the case of the waiver, control operators capable of monitoring ARRL AX.25 packet protocol transmissions must alert the responsible control operator of any intermediate retransmitting station under automatic control of any misuse of the station so that prompt corrective action will be taken.

Conclusion

11. Pursuant to the Regulatory Flexibility Act of 1980, 5 U.S.C. § 605, it is certified that the amended rules will not have a significant impact on a substantial number of small entities because such entities may not use the Amateur service for business communications.[7]

12. The rules contained herein have been analyzed with respect to the Paperwork Reduction Act of 1980 and found to contain no new or modified form, information collection and/or record keeping, labeling, disclosure, or record retention requirements; and will not increase or decrease burden hours imposed on the public.

13. A copy of this Memorandum Opinion and Order will be served on the Chief Counsel for Advocacy of the Small Business Administration.

14. IT IS ORDERED, That Part 97 is amended as set forth below to permit certain amateur stations being operated under automatic control to retransmit digital packet communications containing third-party traffic.

15. IT IS FURTHER ORDERED, That the Petitions for Reconsideration ARE GRANTED insofar as they are consistent with the action taken herein and ARE DENIED in all other respects.

16. IT IS FURTHER ORDERED, That these rule amendments shall become effective November 24, 1986. .

17. This action is taken pursuant to the authority contained in 47 U.S.C. 154 (i) and 303 (r).

18. Information in this matter may be obtained by contacting Maurice J. DePont, (202) 632-4964, Private Radio Bureau, Federal Communications Commission, Washington, D.C. 20554.

FEDERAL COMMUNICATIONS COMMISSION

Willliam J. Tricarico
Secretary

APPENDIX

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is amended, as follows:

1. The authority citation for Part 97 continues to read as follows:

Authority citation: 48 Stat. 1066, 1082, as amended; 47 U.S.C. 154, 303. Interpret or apply 48 Stat. 1064-1068, 1081-1105, as amended; 47 U.S.C. 151-155, 301-609, unless otherwise noted.

2. Section 97.80(b) is revised to read, as follows:

§ 97.80 Operation under automatic control.

* * * * *

(b) No amateur station may be operated under automatic control while transmitting third-party traffic, except an amateur station retransmitting digital packet radio communications on frequencies 50 MHz and above. Such stations must be using the American Radio Relay League, Inc. *AX . 25 Amateur Packet - Radio Link - Layer Protocol, Version 2.0, October 1984 (or compatible)*. The retransmitted messages must originate at an amateur station which is under local or remote control.

* * * * *

3. Section 97.114(b)(4) is revised to read, as follows:

§ 97.114 Third-party traffic.

* * * * *

(b) * * *

(4) Third-party traffic from an amateur station under automatic control, except under the conditions specified in § 97.80(b).

* * * * *

FOOTNOTES

[1] The petitioners are: American Radio Relay League, Inc., S.E. Carlson, Thomas Clark, William Danielson, William Dickson II, Alfred Dynarski, Richard F. Fish, Robert Franklin, Karl Frazer, Edward Ingber, Robert Keller, Lawrence Kenney, Robert Martin, Donald McDougall, Walter E. Miller, Edward Novak, Donald Simon, John T. Smith, Warren Struven, Richard Whipkey, and Eric Williams.

[2] See *AX .25 Amateur Packet - Radio Link - Layer Protocol ; Version 2 .0 , Copyright 1984 by the American Radio Relay League; October 1984.*

[3] Article 1, Section III, Paragraph 3.34, Radio Regulations, Geneva, 1979. See also 47 CFR § 97.3(a) and Appendix 2.

[4] See Report and Order in Docket 20112, adopted June 11, 1975. 40 FR 26524, June 24, 1975.

[5] Section 97.80(a) requires an amateur station operated under automatic control to incorporate devices and to implement procedures which will ensure compliance with the rules even when the control operator is not present at the station control point.

[6] Section 97.113 (c) prohibits amateur stations from retransmitting signals emanating from any class of radio station other than amateur.

[7] See 47 CFR § 97.110.

THE AMERICAN RADIO RELAY LEAGUE, INC.
INTERNATIONAL SECRETARIAT OF THE INTERNATIONAL AMATEUR RADIO UNION
ADMINISTRATIVE HEADQUARTERS NEWINGTON, CONNECTICUT, U.S.A. 06111

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QST
OFFICIAL JOURNAL

October 9, 1986

HF GATEWAY STATIONS

Gentlemen:

This is to bring you up-to-date on the planning process for both the STA and development of a structure to improve HF packet radio relay.

Enclosed is a summary of your responses. The column headings are bit abbreviated but make sense when compared to the questionnaire. Here are some tentative conclusions:

Dig Ctrl: Nineteen stations indicated a digital frequency-control capability. Eight more said "no" but appear to have transceivers that could be digitally controlled.

Freq Recs: All but two accepted the ARRL Digital Committee's frequency recommendations. (There is some fine tuning needed on these frequency recommendations, which I plan to work on. Then, I hope we could pick an implementation date, possibly January 1, 1987. If so, I'll get the word out with some advance notice.)

Like Plan: All but one said they liked the plan in general. The one, W9ZRX, didn't like the implication that AD8I and W9ZRX were excluded. After some review, it is obvious that both of these stations are important resources and should be included in a cluster serving a wide area.

Want STA: All but two said that they want to be included in the STA.

Have 800: Thirteen indicated a capability for 800-Hz shift.

Will 600: All but three (no responses) indicated a willingness to use 600-Hz shift if the hardware is available.

Frequency Coverage: The frequencies listed are no longer current in that some stations have changed from 14107 to a 14109-kHz closed net. (I have talked on the phone with several of you who indicated some concern about whether a closed net is the right thing, and would it foul up "the plan"? My feeling is that access to frequencies for moving long-haul packet traffic needs to be limited to those stations involved and necessary to the network [i.e., cluster to cluster]. The closed frequencies would be the higher ones, for example 10 and 14 MHz during the day. The penalty for not doing this would be to have so many collisions that the main trunks would be clogged. In addition, we need at least one open-access frequency [typically 7 MHz during the day] for VHF-HF gateways to feed into clusters or to intercommunicate directly. I'll try to give you some specific frequency-utilization recommendations as soon as possible.)

We just sent a request to the Institute for Telecommunication Sciences, Boulder, CO, for IONCAP propagation predictions covering 36 paths in the United States. (We already have IONCAP predictions for overseas paths that would be used to select frequencies for international packet gateways.) When they are received, which should be a week or two, they will be used to prepare frequency tables and connectivity tables (by the hour, season and sunspot number) between clusters.

So, the rough firing order is (a) realignment of frequencies according to the Digital Committee's recommendations (after any necessary fine tuning), (b) analyze propagation charts, (c) designate cluster locations and stations, (d) write the STA request, (e) complete the network plan. I appreciate your patience while this analysis is going on; I know you're all interested in seeing some forward motion.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

cc: Digital Committee
Chairman, Blue Ribbon Committee

SUMMARY OF REPONSES FROM HF GATEWAY OPERATORS 10/9/86

Call Sign	Dig Ctrl	Radio Equipment	Freq Recs	Like Plan	Want STA	Have 800	Will 600	Frequency Coverage
N1DL	Yes	IC-720A IC-751	Yes	Yes	Yes	No	Yes	14105 24h; 14107 if traffic
WB1DSW	No	TS-830S	Yes	—	Yes	No	Yes	14107 day; 7093 night
AA2S	Yes	IC-751	Yes	Yes	Yes	Yes	Yes	Off; on about Dec 1
KC2TN	No	Drake TR7	Yes	Yes	Yes	No	Yes	14107 2100-0900Z
W3TMZ	No	IC-720A	Yes	Yes	No	No	Yes	14105 24h
K3VPZ	Yes	TS-930S	Yes	Yes	Yes	No	Yes	14107 24h for STA
K4EID	No	TS-930S	Yes	Yes	No	Yes	Yes	14107 24h; 7093 occasionally
WA4EWV	No	Drake TR7	Yes	Yes	Yes	No	Yes	14107 when active
K4NTA	No	TS-430S	Yes	Yes	Yes	No	Yes	14107
WA4SZK	No	TS-830S	Yes	Yes	Yes	No	Yes	14107 0700-0830, 1700-2400 weekdays; 0700-2400 Eastern weekends
K4TKU	Yes	TS-440S	Yes	Yes	Yes	Yes	Yes	14107 1730-0700 Eastern; 7093 when 20 m out
KI4XO	Yes	FT-757GX	No	Yes	Yes	Yes	Yes	14107, 10147, 7093
KN5D	No	FT-ONE	Yes	Yes	Yes	Yes	Yes	14107; 7093 when 20 m out
WD5GAZ	Yes	IC-701	Yes	Yes	Yes	Yes	Yes	14107 24h
W5XO	No	IC-751	Yes	Yes	Yes	No	Yes	14107 days when home; 7093 nites
WA6CUS	Yes	IC-735	Yes	Yes	Yes	No	Yes	7093 24h
N6EEG	Yes	TS-430	Yes	Yes	Yes	No	Yes	14107; 7093 when 20 m out
WB6KAJ	Yes	FT-757	Yes	Yes	Yes	Yes	Yes	14103 24h
KD6SQ	No	TS-430S	Yes	—	Yes	No	Yes	14107 24h; 7093 occasionally
WB7DCH	Yes	IC-735	Yes	Yes	Yes	No	Yes	14107 24h
N7ML	Yes	IC-745/751	Yes	Yes	Yes	Yes	Yes	Can guard any HF channel anytime
K7PYK	Yes	TS-980	Yes	Yes	Yes	—	—	14107 24h, 7093, 10149.6
KB7TV	No	TS-930S	Yes	Yes	Yes	Yes	—	14107 when not working
AD8I	Yes	TS-940	Yes	Yes	Yes	Yes	Yes	14107 24h; 7093 0000-1130Z winter
WB8LVP	Yes	IC-740 or IC-745	Yes	Yes	Yes	No	Yes	14107 day; 7093 eves
K8MMO	Yes	FT-101ZD FT-757	Yes	Yes	Yes	Yes	Yes	14107 1900-2300 Eastern
WD9DHI	Yes	IC-730	Yes	Yes	Yes	Yes	Yes	14107 1200-0200Z, 7093 0200-1200Z
W9TD	Yes	IC-751	No*	Yes	Yes	No	Yes	14107 weekends
W9ZBD	Yes	TS-940S	Yes	Yes	Yes	No	Yes	14103 or 14107 days; 7093 eves
W9ZRX	Xtal	Drake TR7	Yes	Yes*	Yes	—	Yes	14107 1300-2300Z, 7093 2300-1300Z
N0AN	Yes	TS-940S	Yes	Yes	Yes	No	Yes	14107 M-F 1600-0700, 24h weekends; 7093 when 20 m out
K0HOA	No	IC-740	Yes	Yes	Yes	No	Yes	14107 when home
K0KBY	No	IC-751	Yes	Yes	Yes	Yes	Yes	14107 24h
KI0Q	No	TS-180S	Yes	Yes	—	No	—	14107, 7093
KC0QJ	Yes	IC-745	Yes	Yes	Yes	No	Yes	14107 24h when home
W0RLI	No	TS-930S	Yes	Yes	Yes	No	Yes	14107; 7093 when 20 m out

*W9TD disagrees with 7096 because of splatter from International BC.
W9ZRX disagrees with exclusion of AD8I and W9ZRX.

NEWS RELEASE

RADIO SOCIETY OF GREAT BRITAIN

1 October 1986

Connect International

October sees the launch of a brand new RSGB Newsletter devoted entirely to Packet Radio. **"Connect International"** will run to the equivalent of 11 or 12 pages of A4 sized pages and will be published on the 15th day of each month. Delivery outside Europe will be by air mail.

Content-wise you can expect a very wide range of copy; full length technical articles, discussions on packet hardware, software, protocols, networks and standards, digipeaters and packet switches, mailboxes, news and views, bugs and fixes, beginners column, reference documentation, packet operation, special interest groups, international packet register, satellite and emergency data communication plus a truly international coverage with up-to-the-minute news of activity and developments from packet groups and individuals throughout the World.

"Connect International" is to be edited by Ian Wade, G3NRW, the well-known compiler of the "Data Comms" feature in Radio Communication and will be produced and circulated by the RSGB.

An application form is enclosed - if you wish to subscribe please complete the enclosed form and return it to the Circulation Department at RSGB HQ.

We very much hope that you will be amongst the first to receive this exciting new publication. Please respond by return if you wish to avoid missing the very first issue to be circulated on 15 October 1986.

RSGB

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1. **"Connect International"** has an annual renewal date of 1 July each year. We have therefore given the subscription rate to be enclosed if you wish to subscribe to the next common renewal date of 1 July 1987. The annual rates are: UK - £7.20; Europe - £8.40; Air mail (A) - £8.88; Air mail (B) - £9.24; Air mail (C) - £9.60.

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